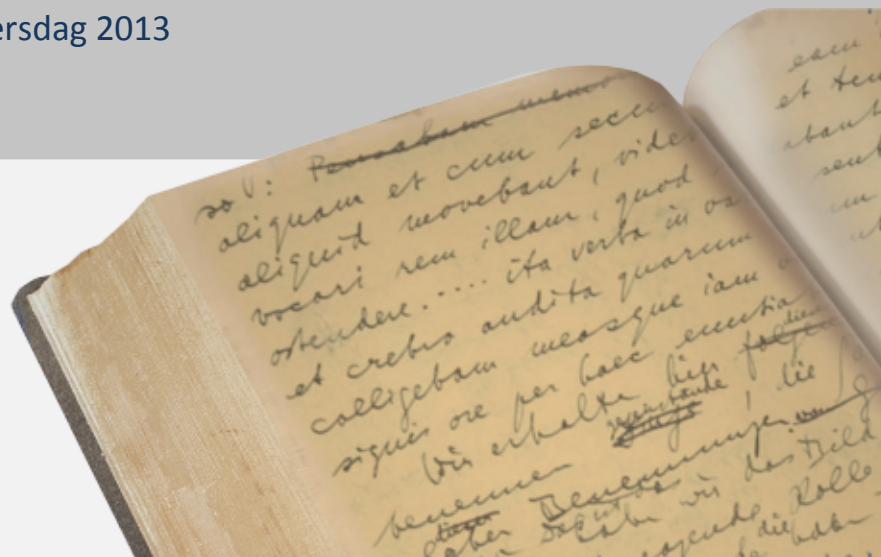


Library Linked Data: Challenges and opportunities of the Linked Data Paradigm

Prof. Dr. Stefan Gradmann (KU Leuven)

LIBISnet Gebruikersdag 2013



Overview

Books and Catalogues

- Monolithic Containers ...
- ... and 'MARC Records'

Hypertext, Linked Data and the Web of Things

- The WWW and its double extension
- The Europeana Data Model (EDM) in this context
- EDM (and RDF) enabling Publishing and Research

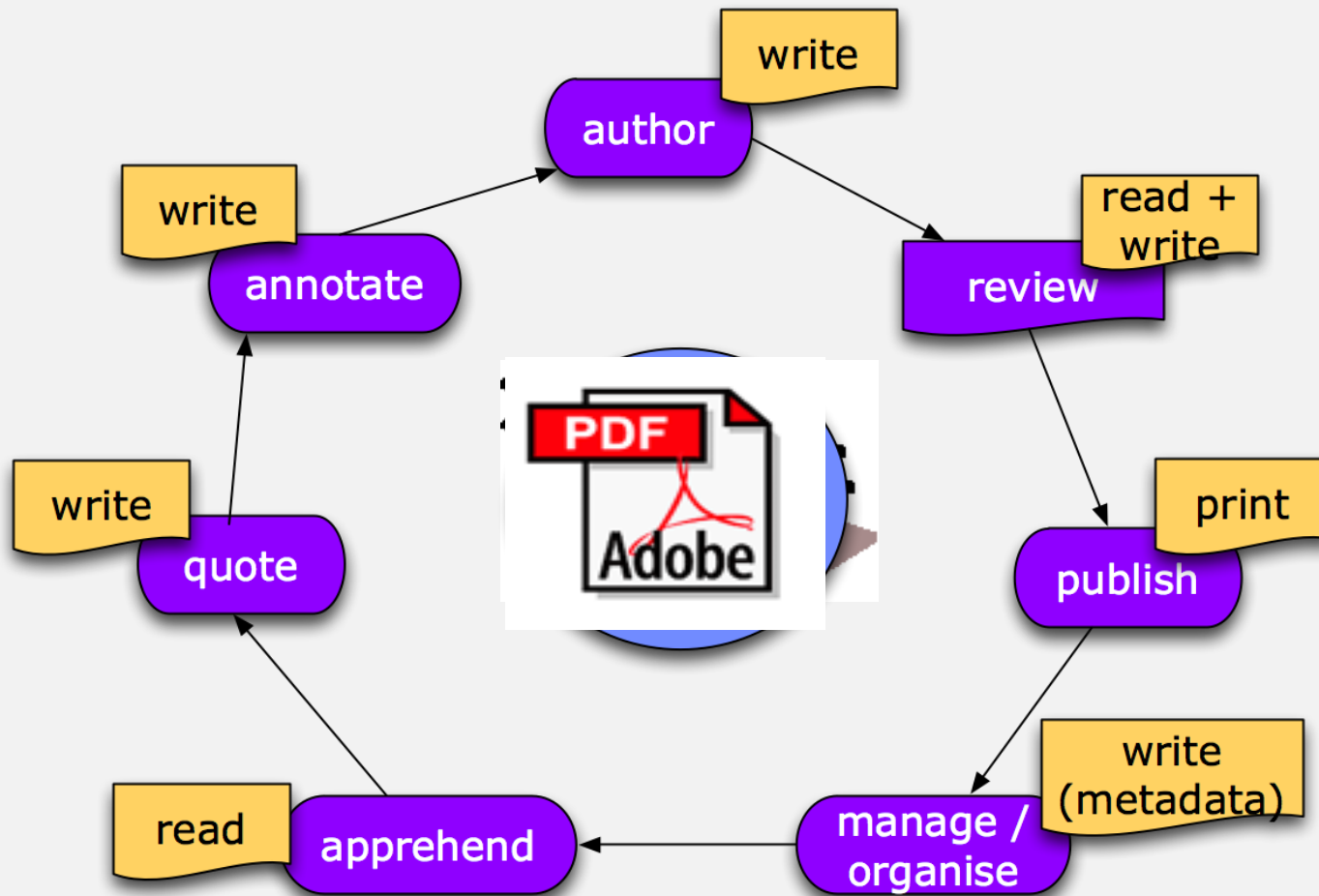
Challenges and Opportunities for Libraries:

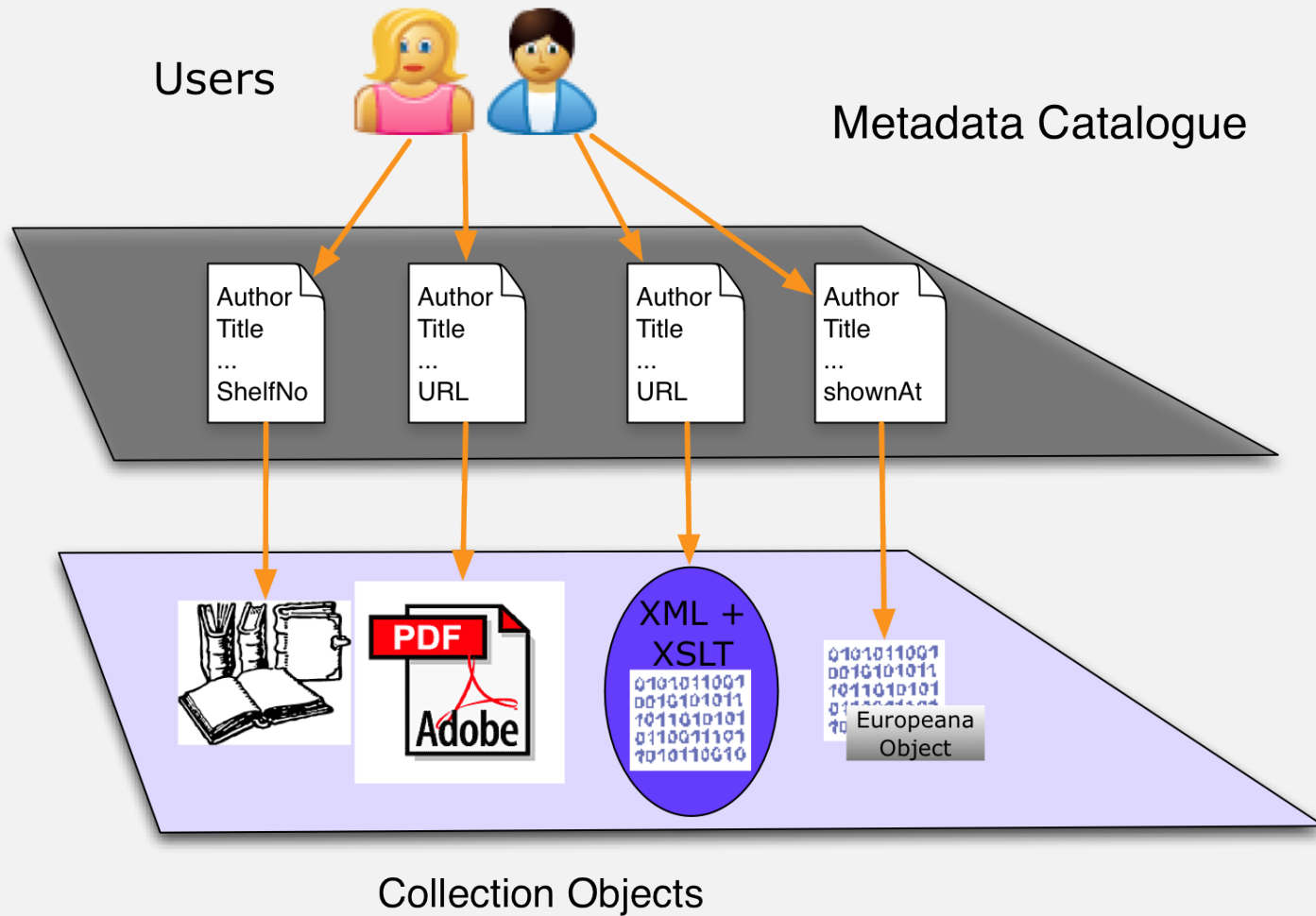
- Opportunities: Content based and context driven services
- Required Cultural Changes: terms/thinking to get rid of

Books and Catalogues

Containers and Records

The Traditional Scholarly Continuum



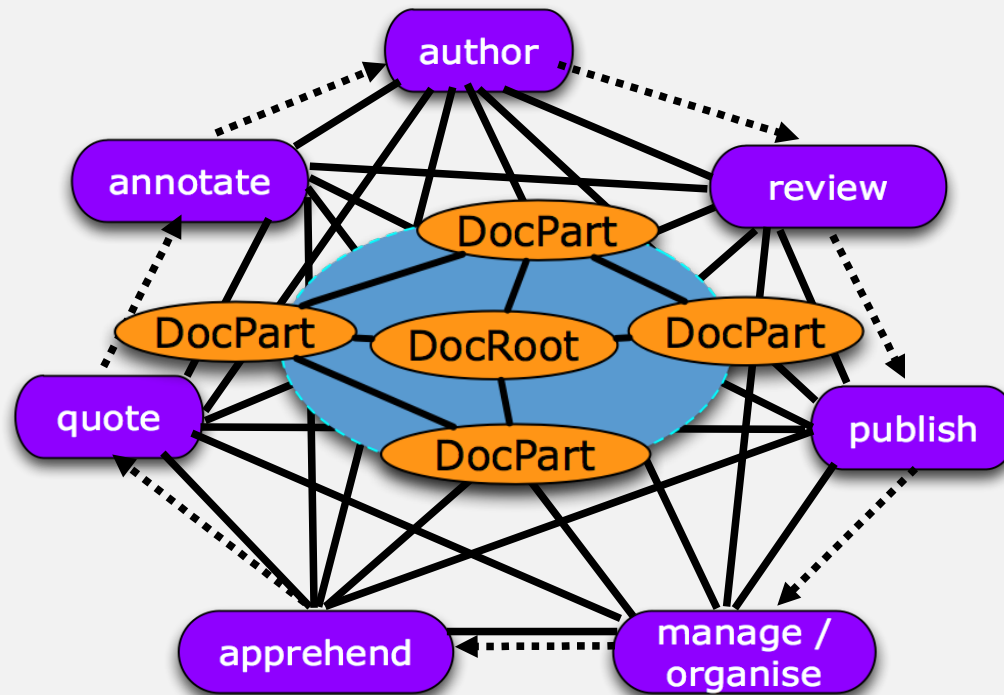


- **Mediating access** to information objects via **catalogues**
- **Mediating links** as pointers from metadata to objects
- Objects are part of a library **collection**
 - An object to be used within a library typically is part of this library's collection
- Internal processing logic: focus on
 - objects as **monolithic containers** of information,
 - not so much on the **content** of these containers
 - and accordingly **cataloguing** is focussed on **container attributes**
- Functional macro-primitives are **ingestion, storage, description** and **retrieval** of information containers

The WWW: DeConstruction of Monoliths and Records

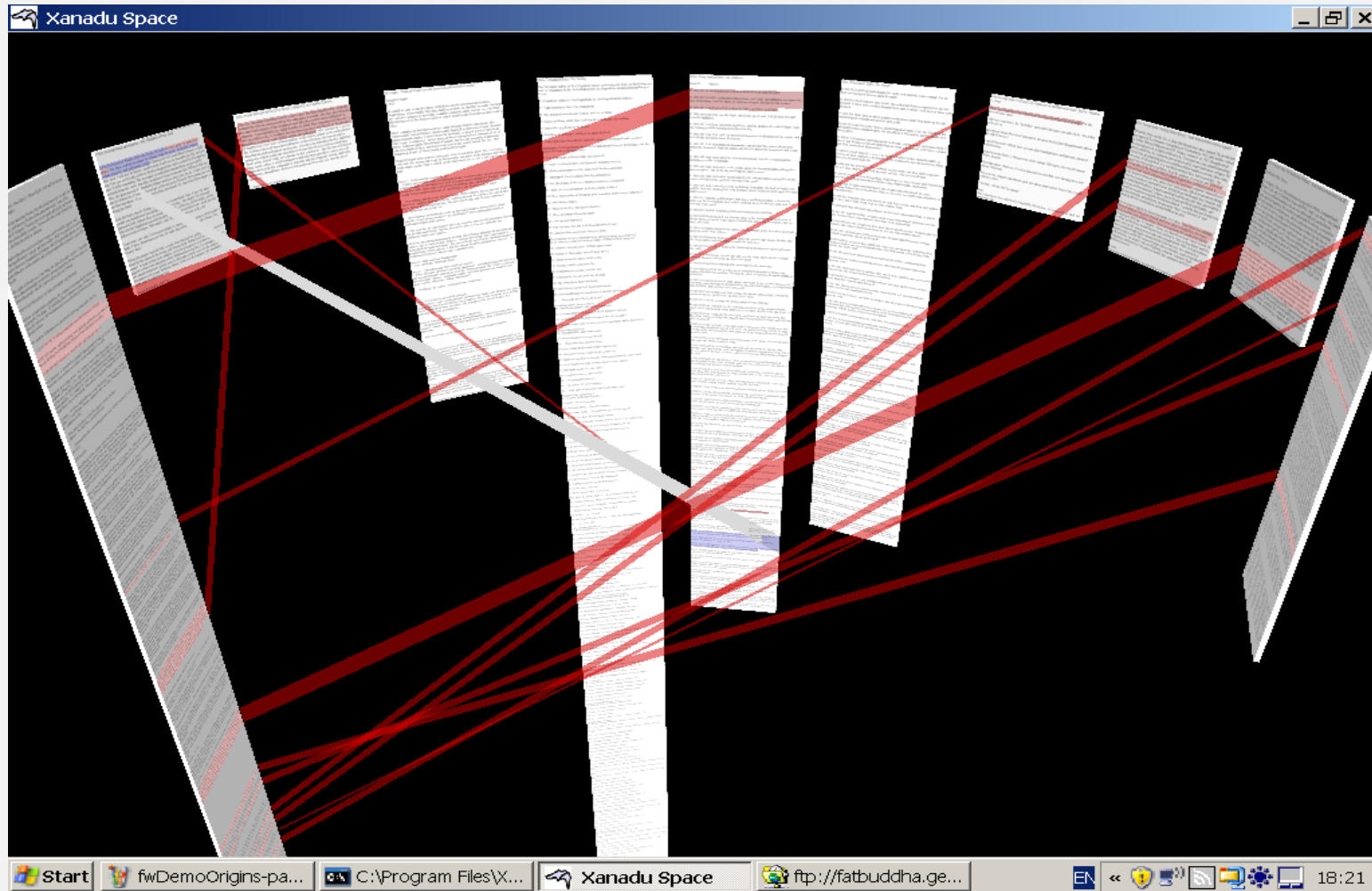


Web Based Scholarly Continuum a triple paradigm shift

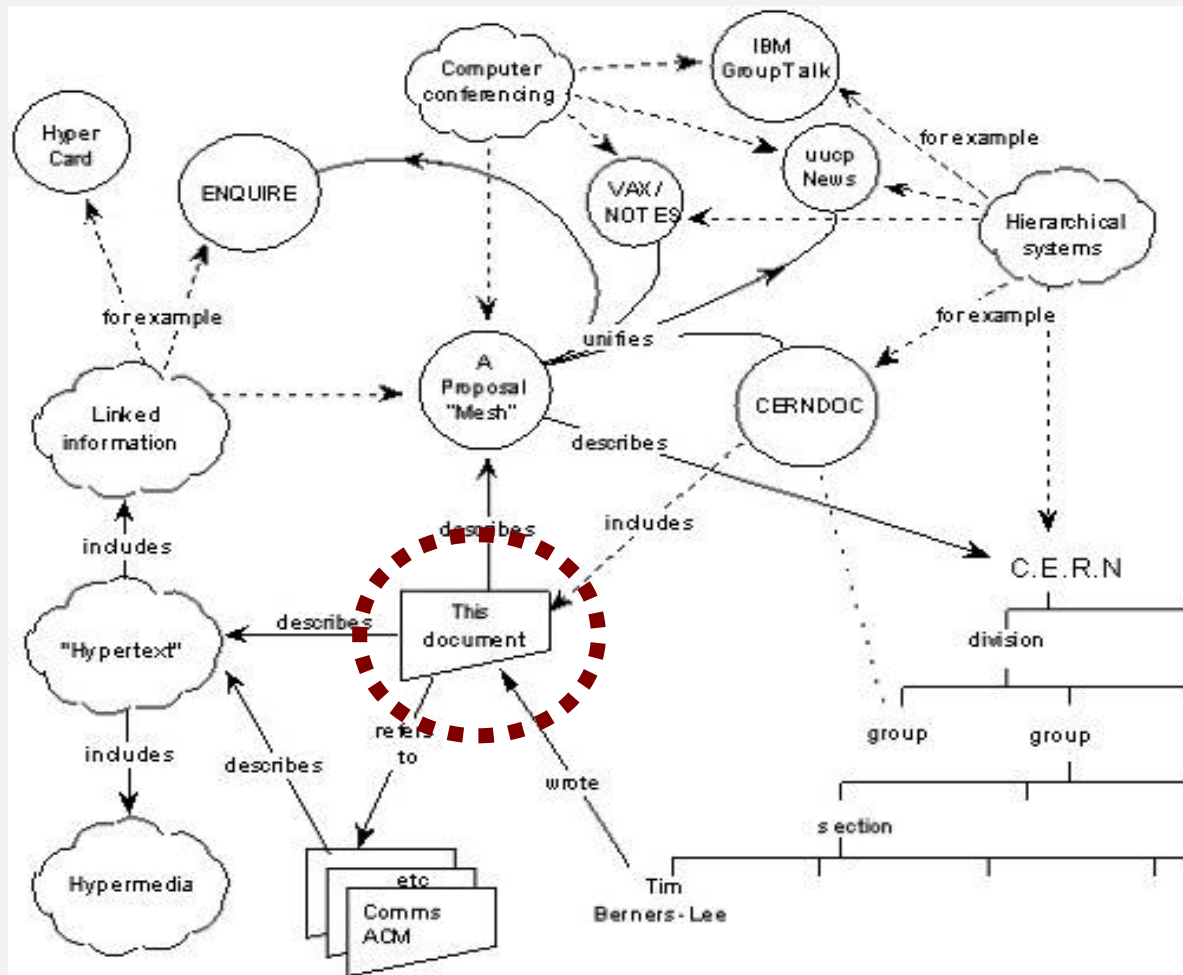


- Decreasing functional determination by traditional cultural techniques
- Disintegration of the linear / circular functional paradigm
- Erosion of the monolithic document notion in hypertext paradigms

Ted Nelson's Xanadu: radicalised Hypertext ...



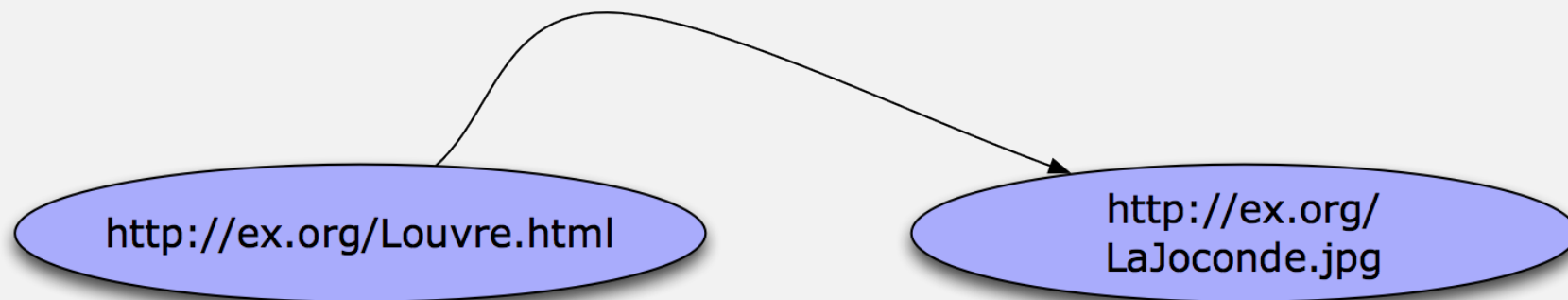
The Web of Documents



Information Management:
A Proposal
(TBL, 1989)

... twice
extended:
• in syntax
• in scope

Resources and Links in the Document Web

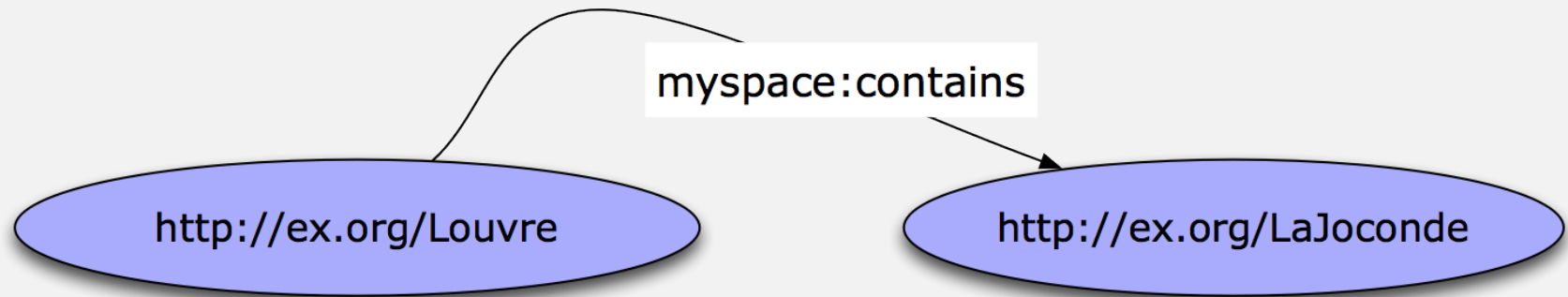


```
<a href="http://ex.org/LaJoconde.jpg">b</a>
```

- We have HTTP URIs to identify resources and links between them – but we are missing a few things!
- What kinds of resources are 'Louvre.html' and 'LaJoconde.jpg'?
 - A machine cannot tell.
 - Humans can: we recognize implied context!
- How exactly do they relate to each other?
 - A machine cannot tell.
 - Humans can: again we recognize implied context!

Syntactically Extending the Document Web (1)

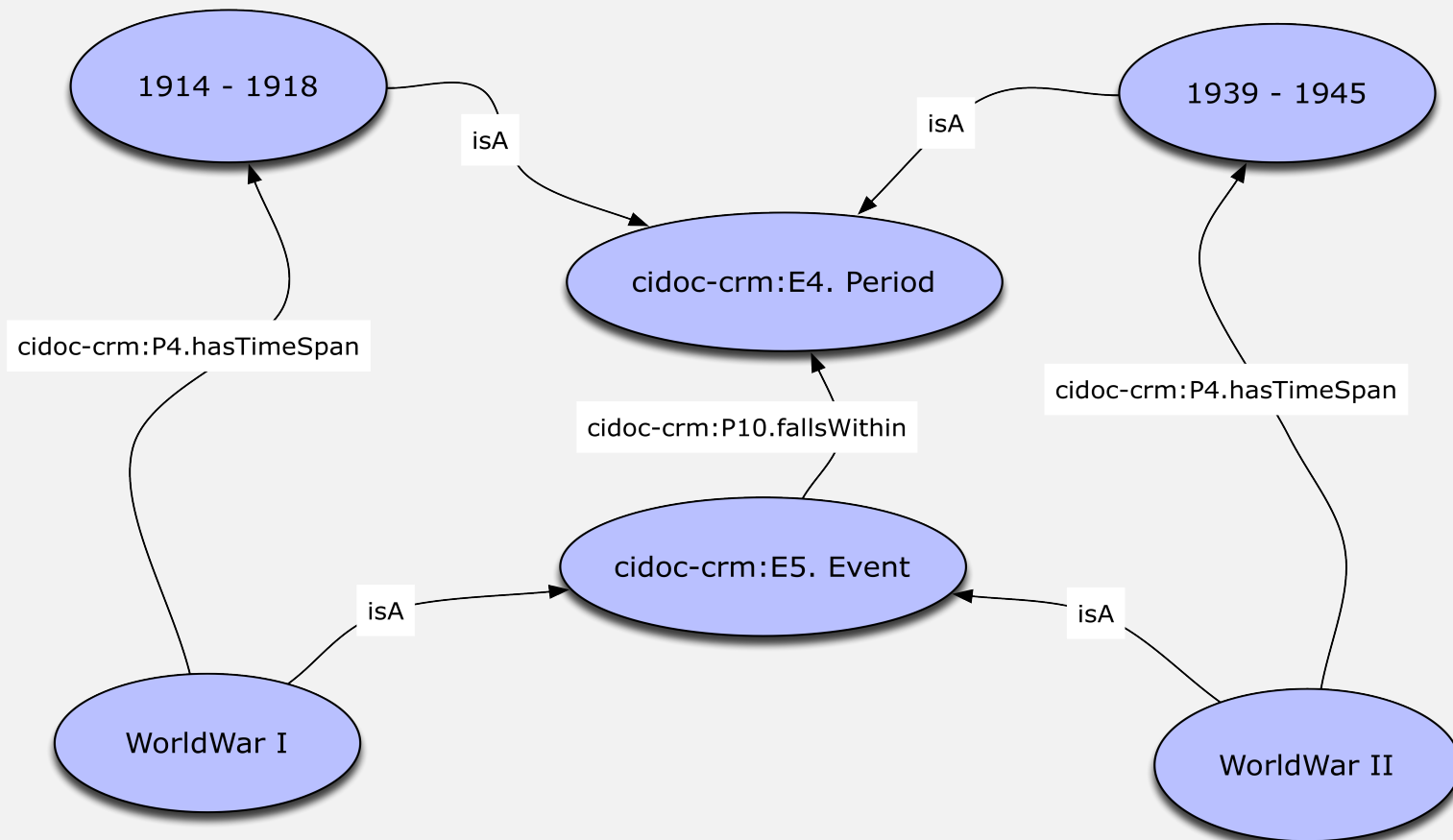
- We add a syntax for making statements on resources: RDF triples



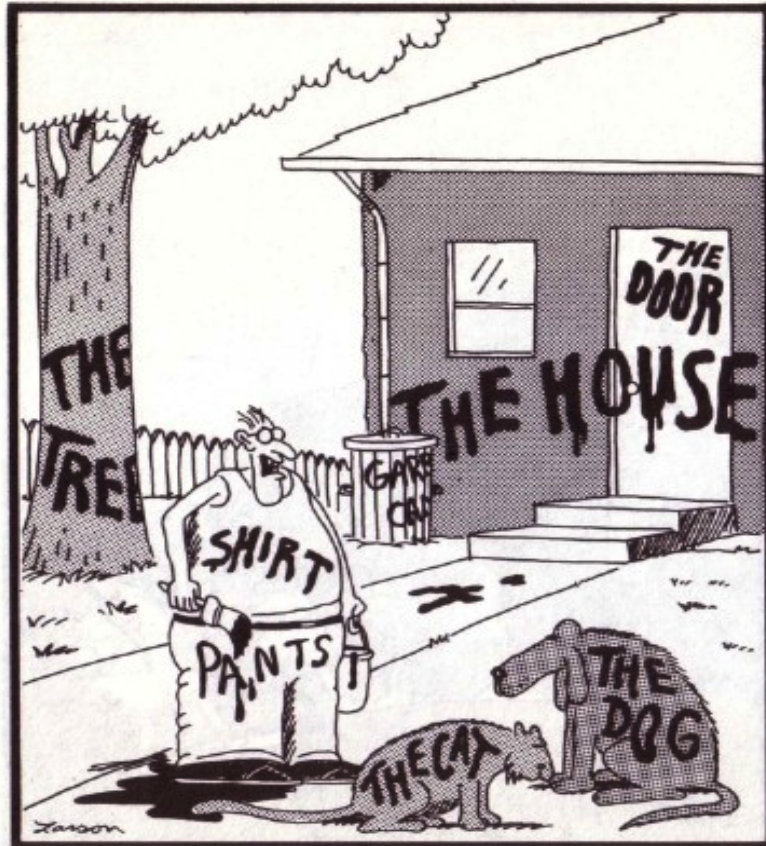
- We add a schema language (RDFS) with elements such as
 - classes (chair' as instance of chairs),
 - hierarchies of classes and properties (chairs are a subclass of furniture, 'teaches' is a sub-property of 'communicates')
 - inheritance (communication based on language → teaching also is)
 - support for basic inferencing, deterministic logical operations

Syntactically Extending the Document Web: RDF (2)

- And thus are able to establish structures in triple aggregations resulting in lightweight domain ontologies:



Extending the Web in Scope: The Web of Things ... (slightly Mistaken)

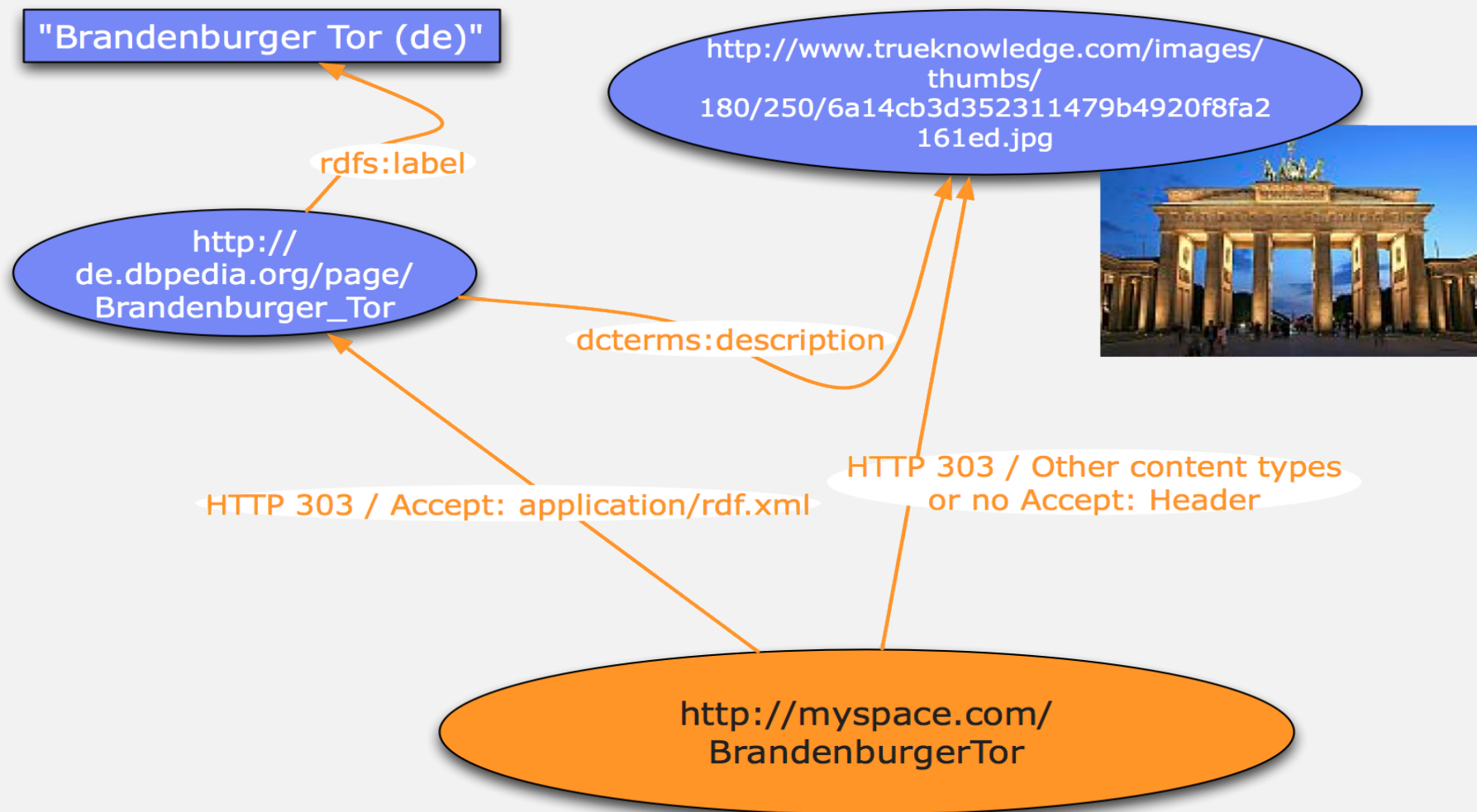


"Now! ... That should clear up
a few things around here!"

What's **wrong**
with this picture?

Taken from Ronald Carpentier's
Blog at
<http://carpentier.wordpress.com/2007/08/08/1-2-3/>

... and the Way we extend the Web in scope to make it a 'Web of Things'



And we get ... Linked Data

Linked Data essentials

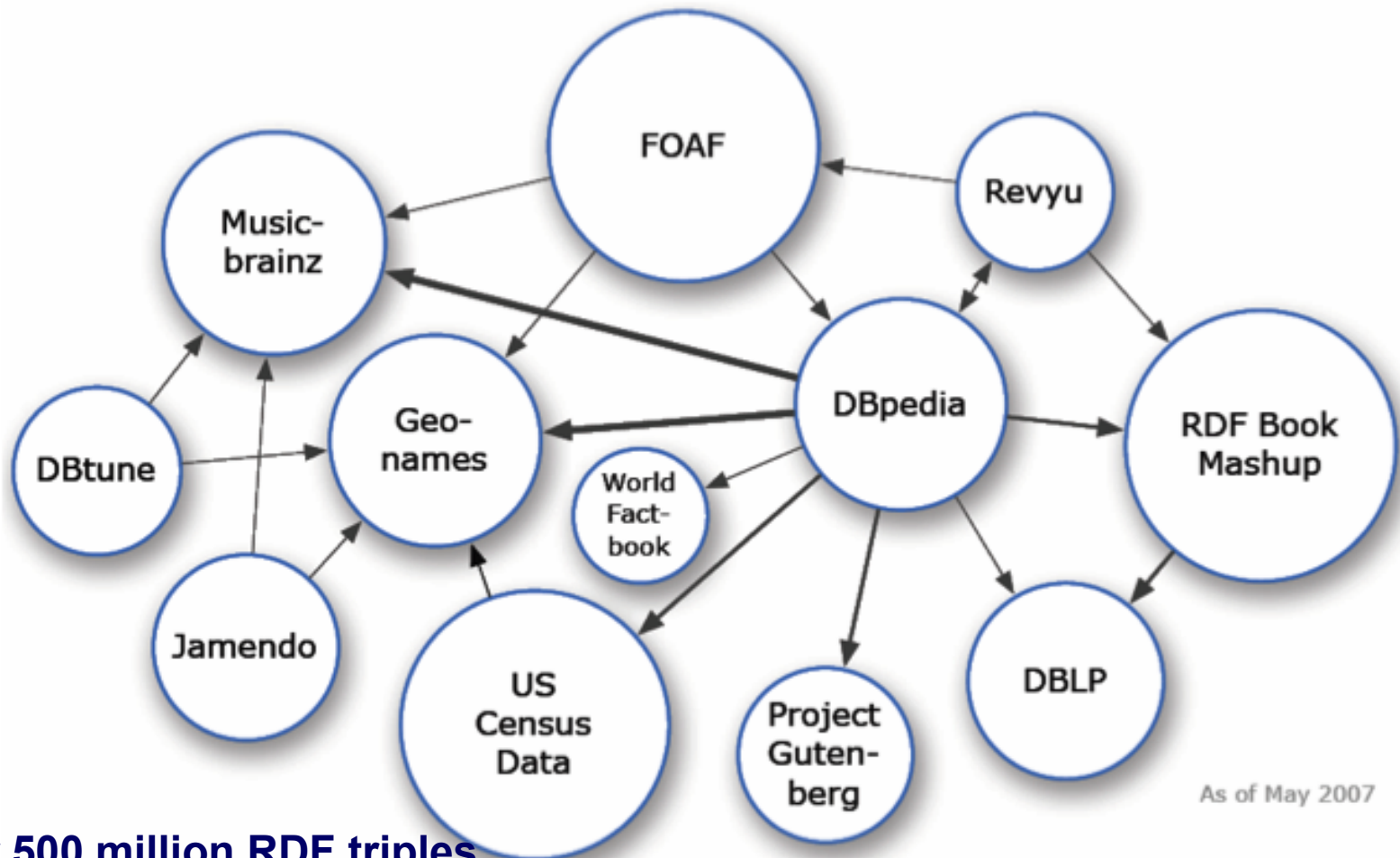
1. Use URIs Standard **Identifiers**
 2. Use HTTP URIs Standard **Pointers**
 3. Serve useful information using SPARQL, RDF standards
 4. Mention URIs of related objects Standards for **Queries**
and **Statements**
- Link** to Context

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[http://www.w3.org/2008/Talks/0617-lod-tbl/#\(4\)](http://www.w3.org/2008/Talks/0617-lod-tbl/#(4))



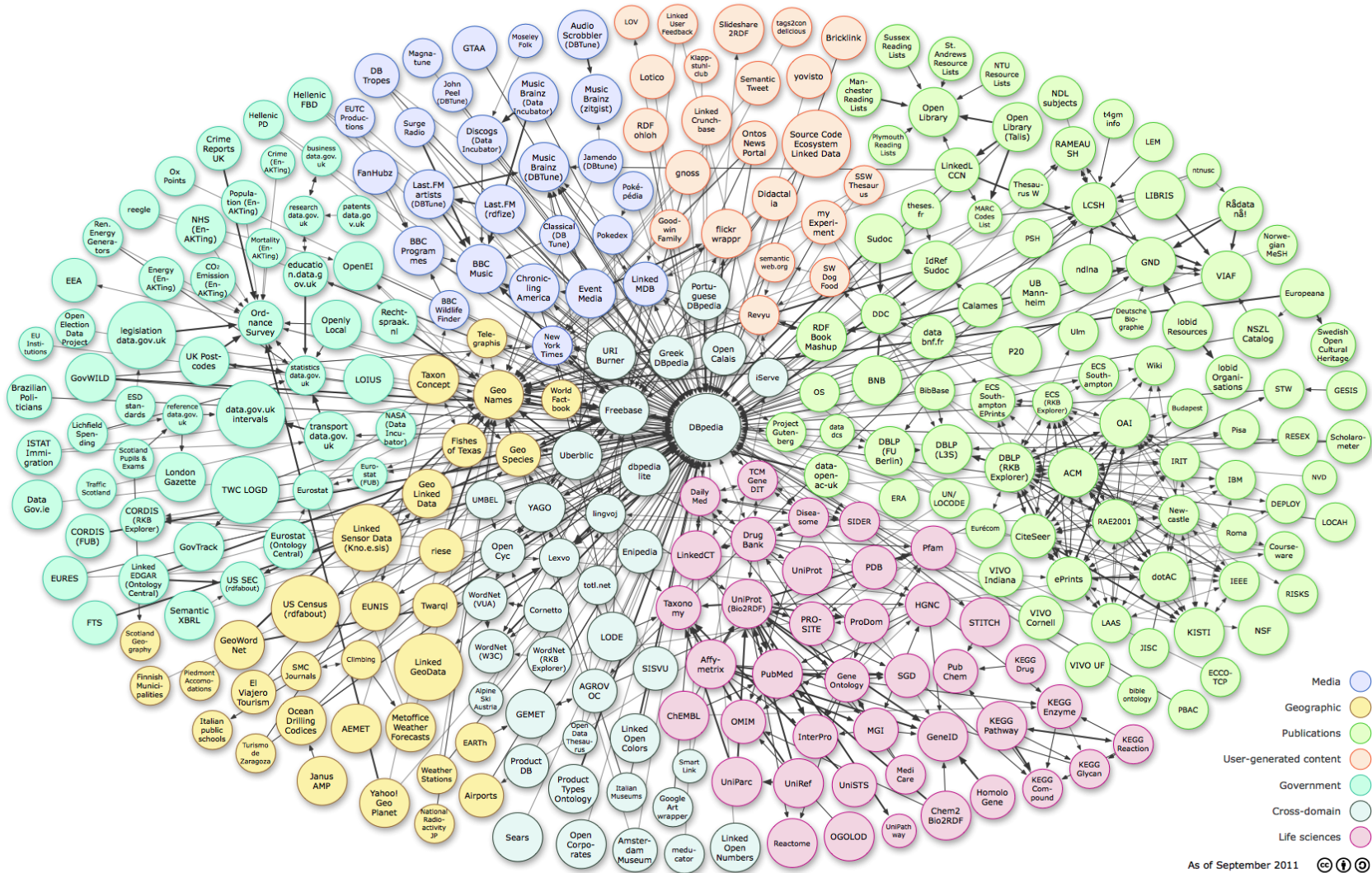
A few Bubbles: 5/2007



- Over 500 million RDF triples
- Around 120,000 RDF links between data sources

© Richard Cyganiak

And a lot of Bubbles as of last Year



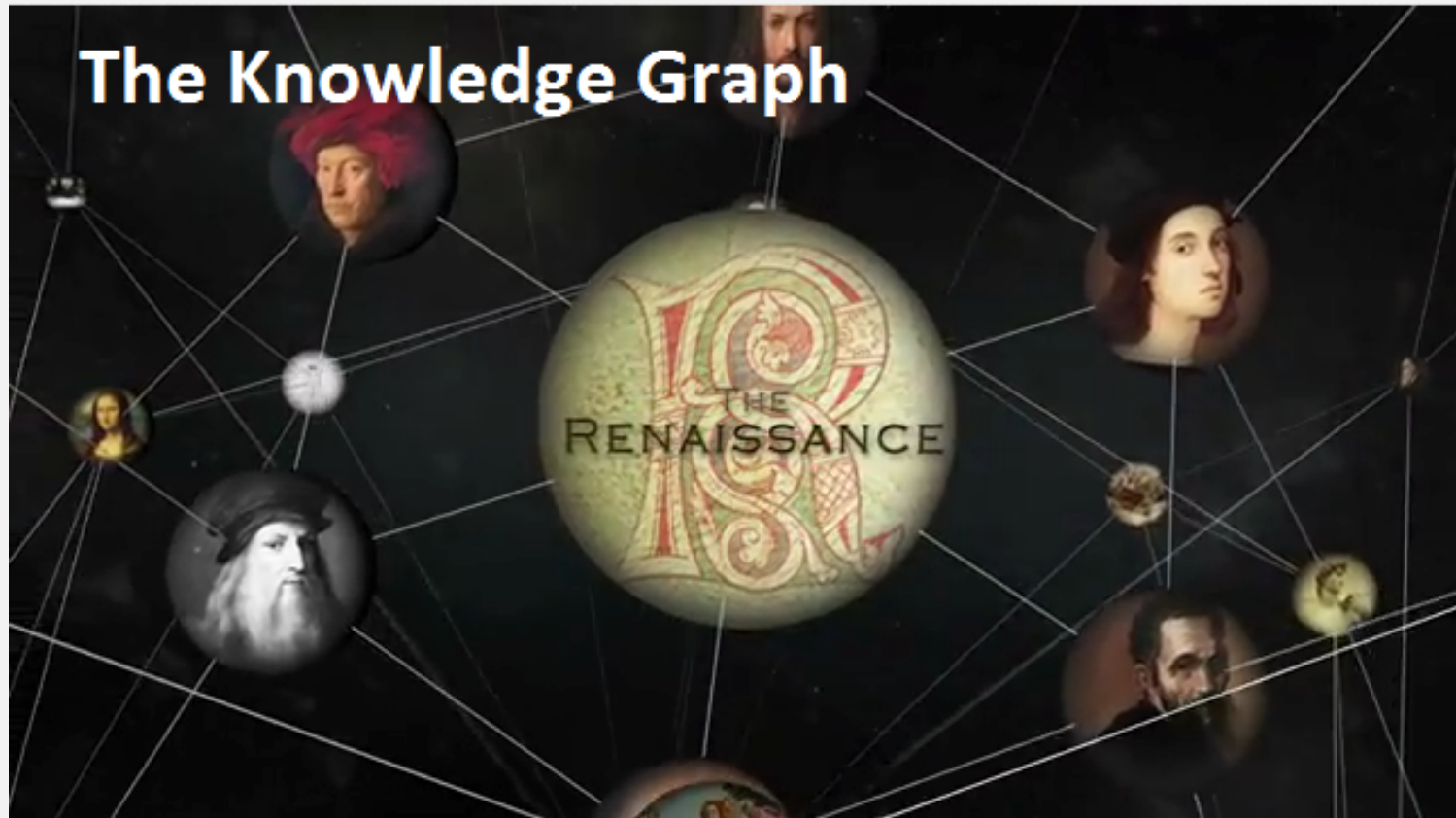
Library Linked Data

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... and a better way of representing them

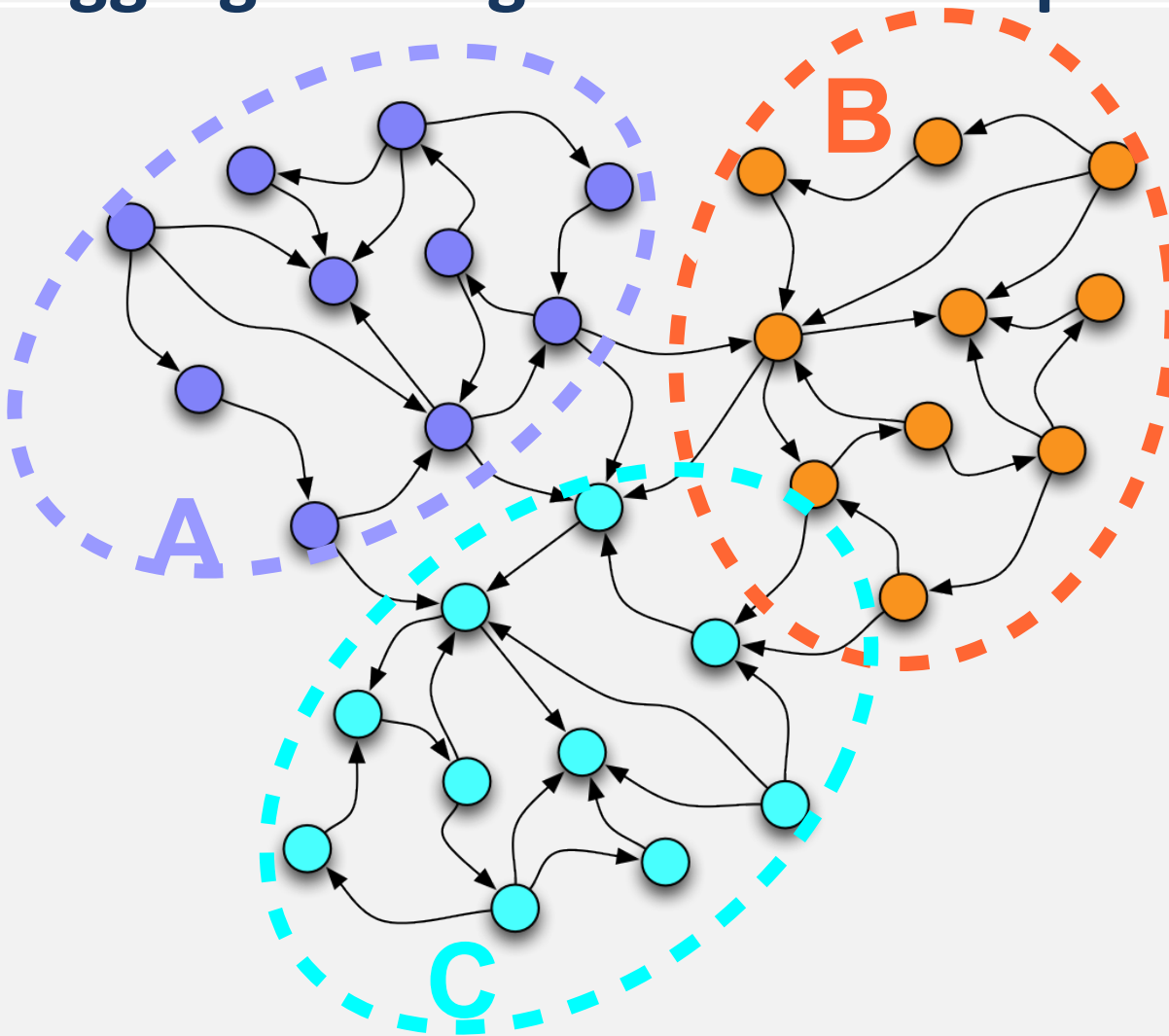
- <http://lov.okfn.org/dataset/lov/>

Google entering the Floor



Modelling Object Representations as RDF

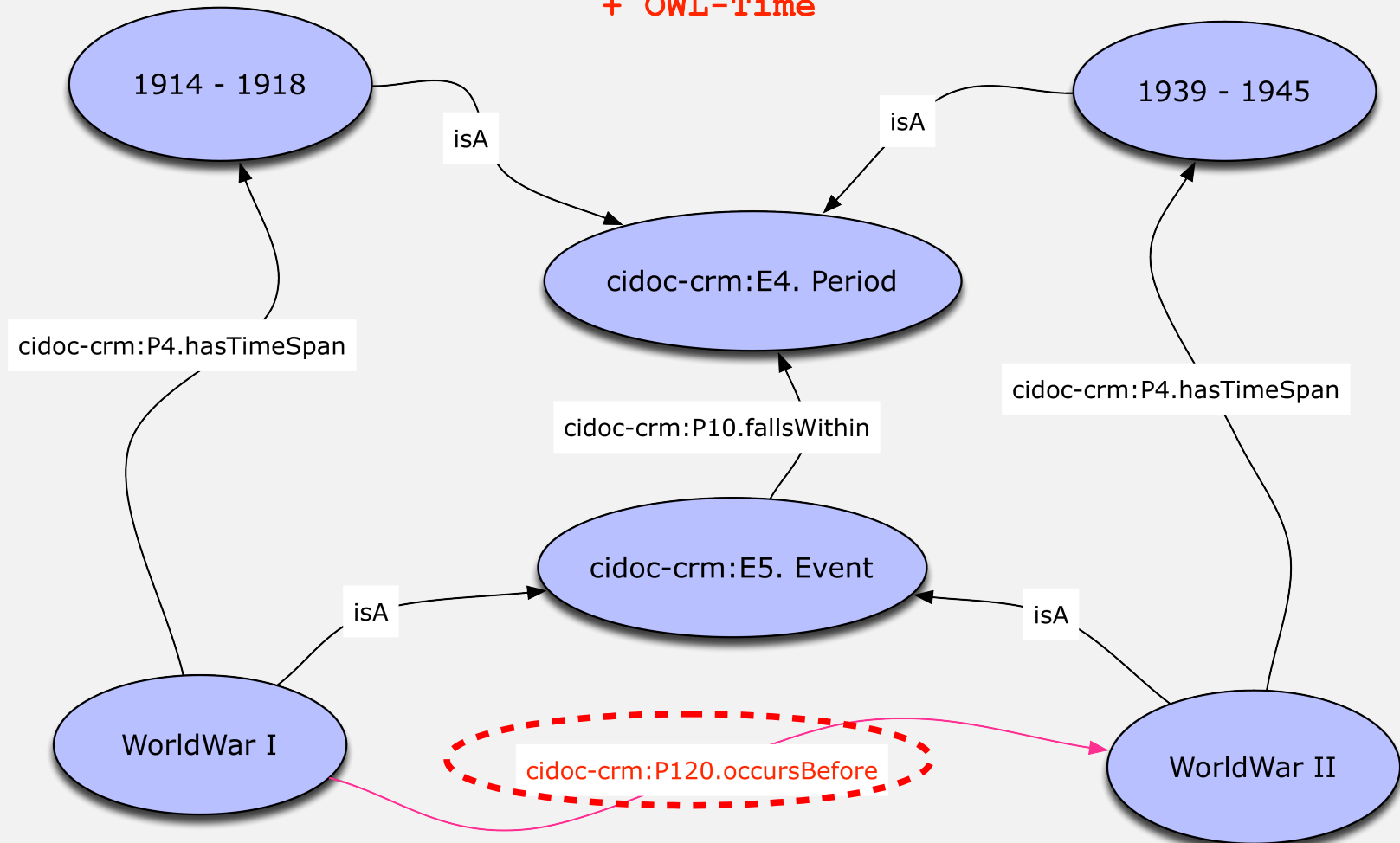
Aggregations generates new questions ...



- Where do resource aggregations 'start'? Where do they 'end'?
 - And what constitutes document boundaries??
 - And which node was connected to which one at a given time???
- Provenance,
Versioning,
Authorisation: Named
Graphs

... and new opportunities: Triple Sets and 'Reasoning'

+ OWL-Time



... based on 'Documents' as Aggregations of RDF-Triples (1)

Assertion

NG_000007.
3:g.70628G>A

has
frequency

0.25%

Condition

Sardinian

Provenance

Giardine et al

'Documents' as Aggregations of RDF-Triples (2)

```
<nanopublication id="0">
```

```
<assertion>  
  <subject>NG_000007.3:g.70628G>A</subject>  
  <predicate>has variant frequency</predicate>  
  <object>0.25%</object>  
</assertion>
```

```
<condition>Sardinian</condition>
```

```
<provenance>  
  <dateofcreation>March 24, 2011</dateofcreation>  
  <lastedit>March 24, 2011</lastedit>  
  <evidenceType>empirical</evidenceType>  
  <authorID>Giardine et. al.</authorID>  
  <curatorID>unresolved</curatorID>  
  <registrantID>Mons et. al.</registrantID>  
  <PMID>6695908</PMID>  
  <PMID>1428944</PMID>  
  <PMID>1610915</PMID>  
  <DOI>http://dx.doi.org/10.1038/ng.785</DOI>  
  <linkout>http://globin.bx.psu.edu/cgi-bin/hbvar/query_vars3?  
mode=output&display_format=page&i=239</linkout>  
  <linkout>http://phencode.bx.psu.edu/cgi-bin/phencode/phencode?  
build=hg18&id=HbVar.239</linkout>  
</provenance>
```

```
<nanopublication id="0">
```

The use of Inferences

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van Haagen HHHBM, 't Hoen PAC, Botelho Bovo A, de Morrée A, van Mulligen EM, et al. (2009) Novel Protein-Protein Interactions Inferred from Literature Context. PLoS ONE 4(11): e7894. doi:10.1371/journal.pone.0007894 / Example provided by Jan Velterop

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RESEARCH ARTICLE OPEN ACCESS

Novel Protein-Protein Interactions Inferred from Literature Context

Article Metrics Related Content Comments: 0

Herman H. H. B. M. van Haagen^{1*}, Peter A. C. 't Hoen¹, Alessandro Botelho Bovo², Antoine de Morrée¹, Erik M. van Mulligen¹, Christine Chichester¹, Jan A. Kors¹, Johan T. den Dunnen¹, Gert-Jan B. van Ommen¹, Silvère M. van der Maarel¹, Vinícius Medina Kern², Barend Mons¹, Martijn J. Schuemie¹

1 Biosemantics Association, Department of Human Genetics, Leiden University Medical Center, Leiden, and Department of Medical Informatics, Erasmus University Medical Center, Rotterdam, The Netherlands, **2** Post-Graduate Program in Knowledge Engineering and Management (EGC), Federal University of Santa Catarina (UFSC), Florianópolis, Brazil

Abstract [Top](#)

We have developed a method that predicts Protein-Protein Interactions (PPIs) based on the similarity of the context in which proteins appear in literature. This method outperforms previously developed PPI prediction algorithms that rely on the conjunction of two protein names in MEDLINE abstracts. We show

To add a note, highlight some text. [Hide notes](#)
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Data = Publication

- Distinction data vs. publication gets **increasingly obsolete** in semantic publishing environments ...
- ... at least in the STM sector.
- The move into semantic publication will be **much slower in the SSH** because of
 - fuzzy and unstable **terminology**
 - fuzzy **linking semantics** hard to formalise consistently
 - close relation between **complex document formats** and **scholarly discourse**
- Current examples are mostly from the medical and bio-medical area as a consequence

→ Visualise and Explore Cultural Context

- Mapping the Republic of Letters:

<http://knot-dev.herokuapp.com/investigate.html>

- Or again the graph of writers and thinkers and how they are connected:

<http://zoom.it/Vj6F> (is this one really useful?)

<http://bgriffen.scripts.mit.edu/www/media/json/thinkers/>

<http://mariandoerk.de/edgemaps/demo/>

<http://www.visualdataweb.org/refinder/refinder.php>

- Or again a Finnish example (Kulttuurisampo):

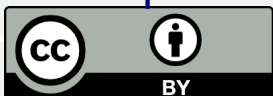
<http://www.kulttuurisampo.fi/kulsa/historiallisetKartat.shtml>

- Or finally Obama vs. Palin:

http://truthy.indiana.edu/memedetail?id=324&resmin=45&theme_id=4 vs.

http://truthy.indiana.edu/memedetail?id=783&resmin=45&theme_id=4

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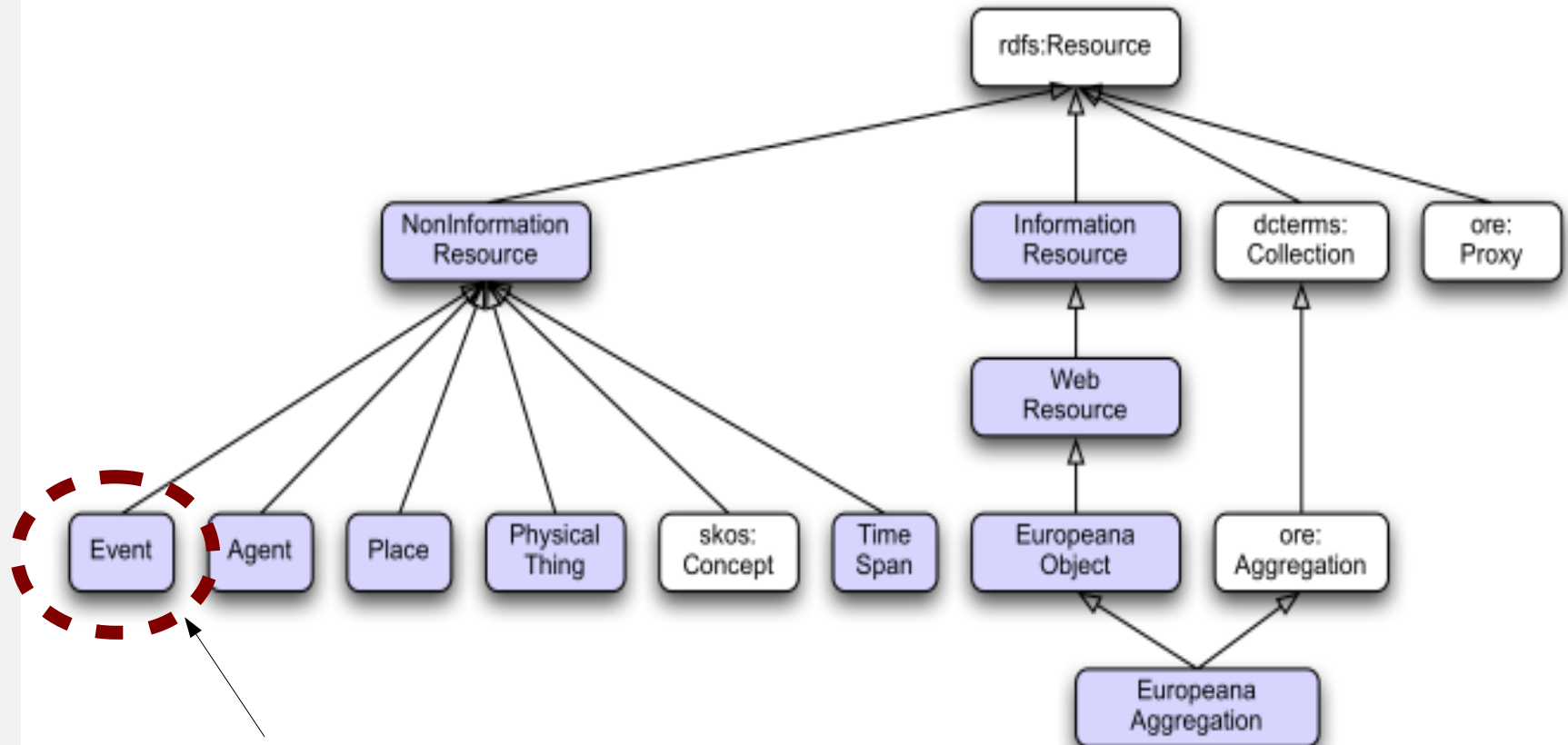


The Europeana Data Model (EDM) in the LoD Context

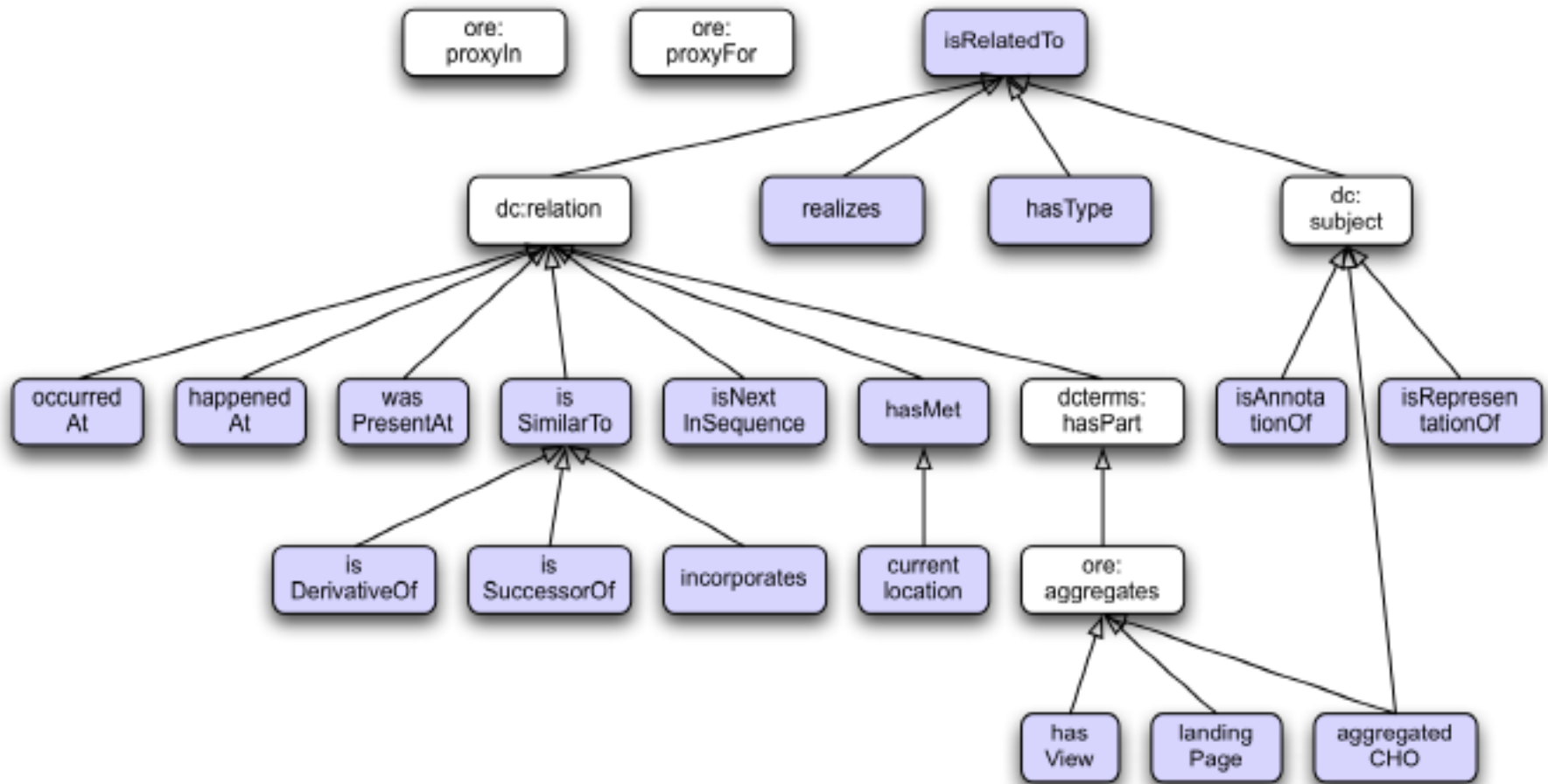
EDM – what is it?

And what not?

- EDM is the **metadata model** replacing the ESE ...
- ... a model for making statements about **digital representations** of cultural heritage objects
- ... a model for **contextualising** such representations
- EDM is **not an object model** (but might be combined with object and process models)!
- EDM is an **RDF based graph model**
- *EDM enables modeling of objects and context and thus **knowledge generation***



CIDOC CRM E5 hierarchy
could be pruned here



Mona Lisa: French Ministry of Culture

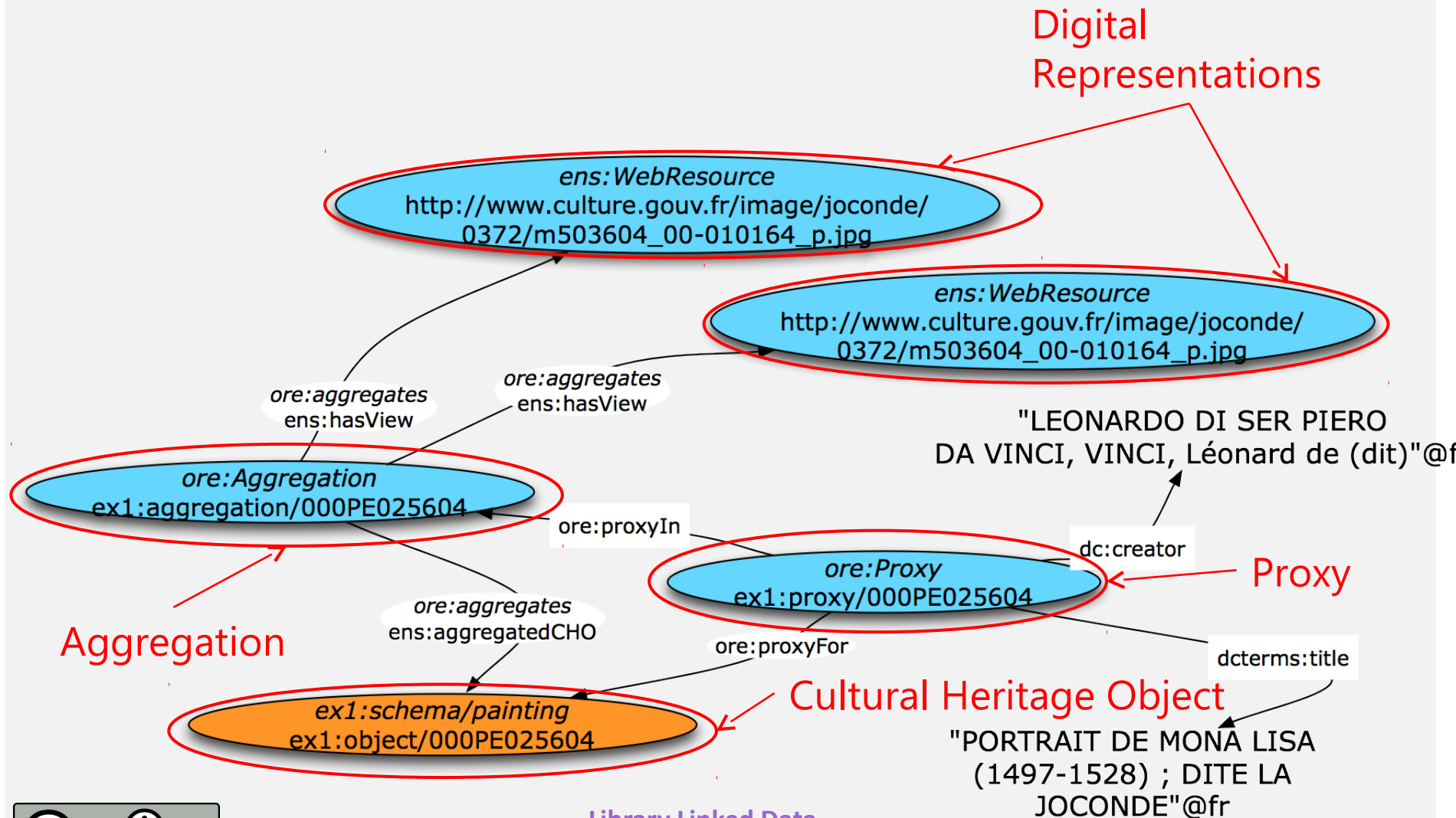
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Réponse n° 1



Domaine	peinture
Type d'objet	tableau
Titre	PORTRAIT DE MONA LISA (1479-1528) ; DITE LA JOCONDE
Auteur/exécutant	LEONARDO DI SER PIERO DA VINCI ; VINCI Léonard de (dit)
Précision auteur/exécutant	Vinci, 1452 ; Amboise, 1519
Ecole	Italie
Période création/exécution	1er quart 16e siècle
Millésime création/exécution	1503 entre ; 1506 et
Genèse	oeuvre en rapport ; reproduit en gravure
Historique	commandé par le florentin Francesco del Giocondo, époux de Mona Lisa entre 1503 et 1506 ; nombreuses copies dont une conservée au Louvre ; gravé par Fauchery, par Filhol, par Landon
Matériaux/techniques	peinture à l'huile ; bois
Mesures	77 H ; 53 L
Sujet représenté	portrait (Mona Lisa, femme, à mi-corps, de trois-quarts, assis, accoudé, loggia, Italien) ; fond de paysage (montagne, rocher, cours d'eau, pont, plaine, route)
Date sujet représenté	1479-1528
Lieu de conservation	Paris ; musée du Louvre département des Peintures
	 <i>Musée de France</i> <i>au sens de la loi n° 2002-5 du 4 janvier 2002</i>
Statut juridique	propriété de l'Etat ; musée du Louvre département des Peintures
Anciennes appartenances	François 1er ; Couronne de France
Numéro d'inventaire	INV 779
Commentaires	légère diminution du tableau sur les côtés (environ 7 mm) ; acheté vraisemblablement vers 1519, après la mort de l'artiste
Bibliographie	HEYDENRICH 6 ; OTTINO DELLA CHIESA 31 ; VILLOT I 484 ; HAUTECOEUR 1601 ; C.S.I. 1981, P 192
Copyright notice	© Musée du Louvre, © Direction des Musées de France, 1999
Crédits photographiques	© Réunion des musées nationaux ; © Hervé Lewandowski ; © Thierry Le Mage
	 commande reproduction et/ou conditions d'utilisation
	renseignements sur le musée
	000PE025604

Metadata Record in EDM



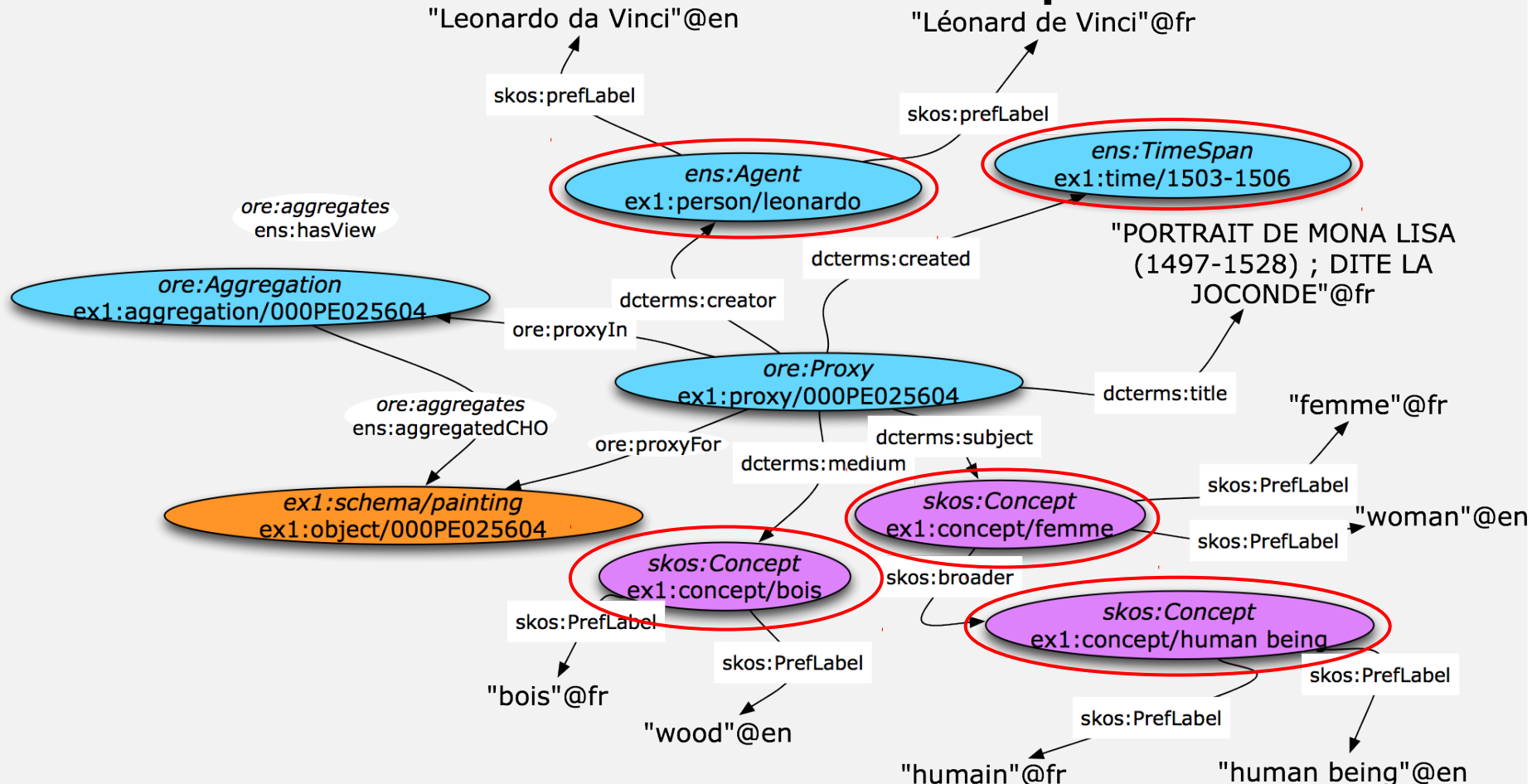
Semantic Enrichment

ens:Agent: persons or organizations

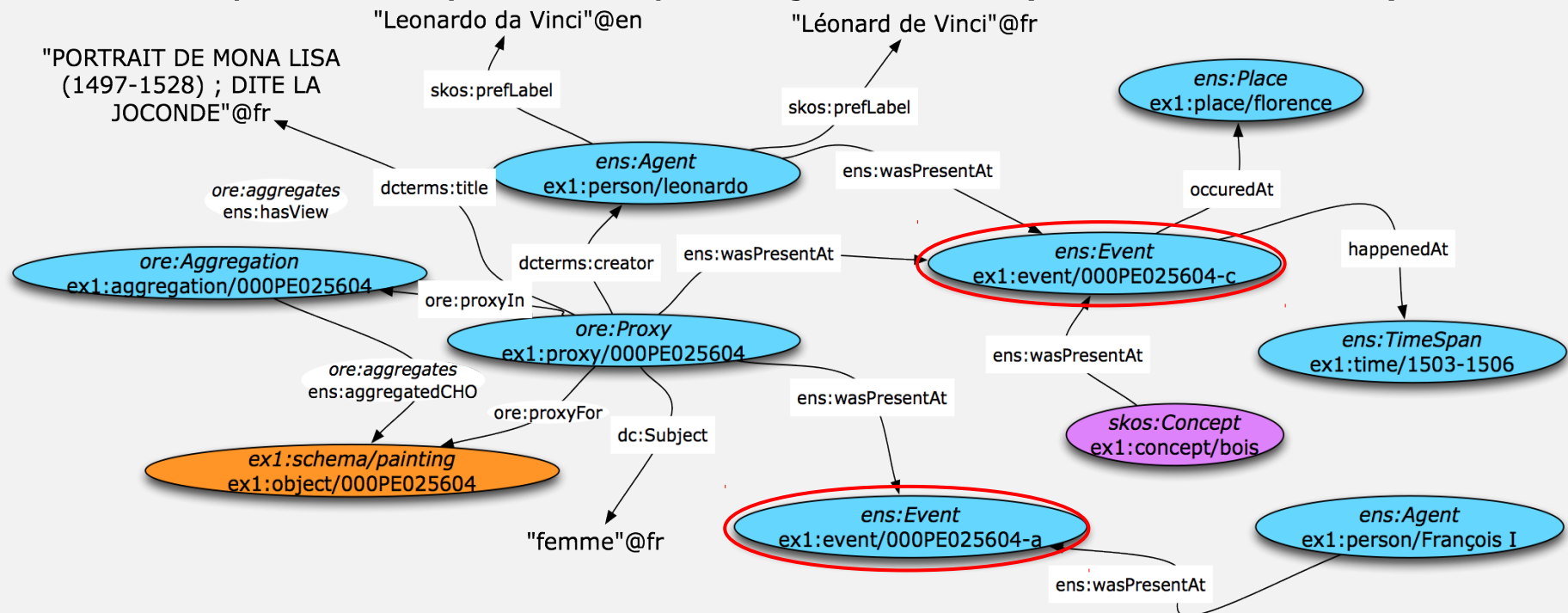
ens:Place: spatial entities

ens:TimeSpan: time periods or dates

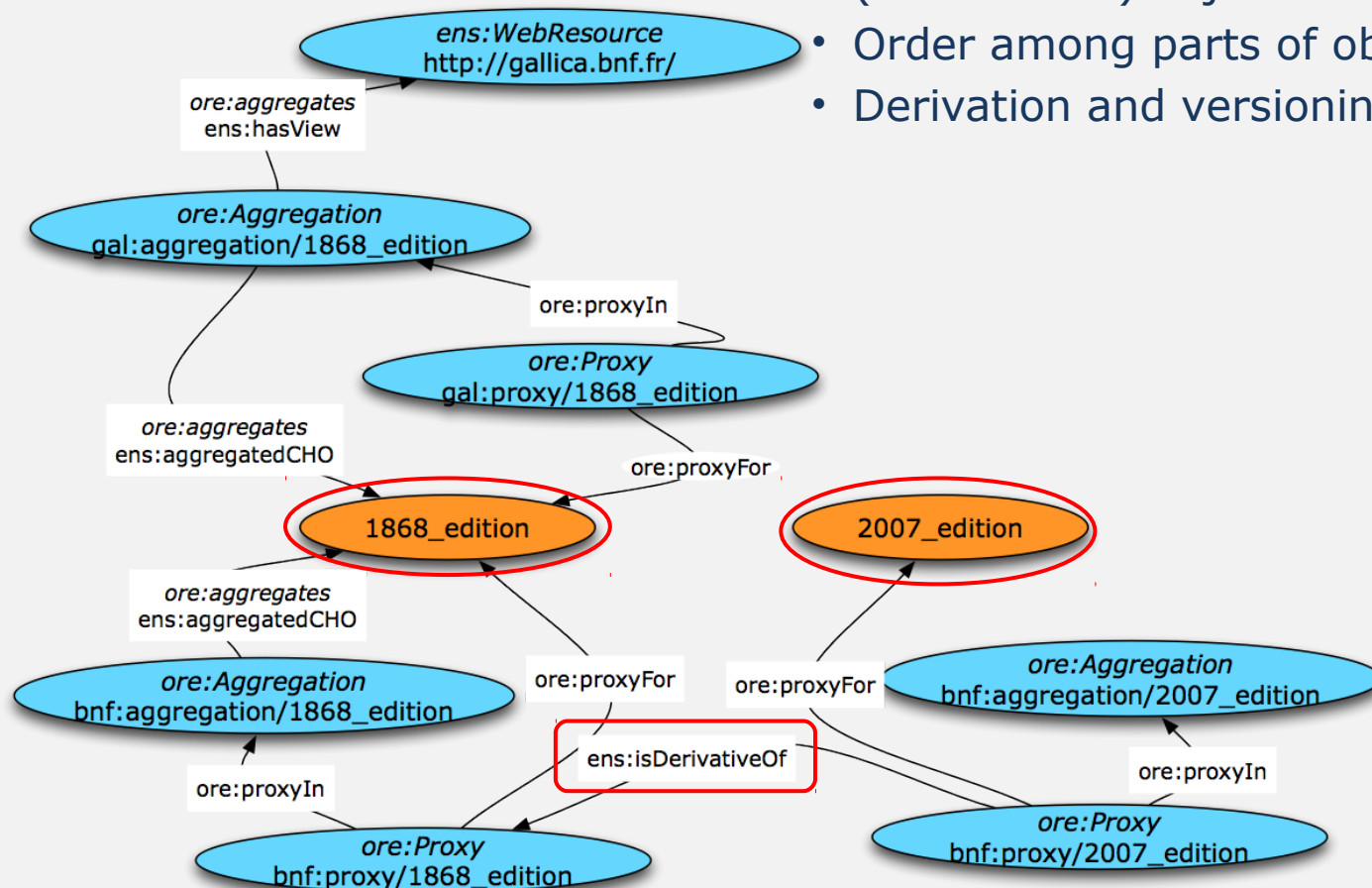
skos:Concept: entities from KOS



Preserving and exploiting original data also means being compatible with descriptions beyond simple object level (→ CIDOC CRM!)



- Part-whole links for complex (hierarchical) objects
- Order among parts of objects
- Derivation and versioning relations



Les Fleurs du Mal: UNIMARC

<http://catalogue.bnf.fr/ark:/12148/cb37367035f>

000 nam 22 450

001FRBNF373670350000003

009<http://catalogue.bnf.fr/ark:/12148/cb37367035f>

039 \$oGEA\$a000288182

100 \$a19920409d1857 m y0frey50 ba

1010 \$afre

102 \$aFR

105 \$a||||z 00|||

106 \$ar

2001 \$a^Les %fleurs du mal\$bTexte imprimé\$fpar Charles Baudelaire

210 \$aParis\$cPoulet-Malassis et De Broise\$d1857

215 \$a248 p.\$d19 cm

676 \$a841.8\$v22

686 \$a840\$2Cadre de classement de la Bibliographie nationale française

700 |\$311890582\$aBaudelaire\$bCharles\$4070

801 0\$aFR\$bBNF\$c19920409\$gAFNOR\$2intermrc

Les Fleurs du Mal: Gallica

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<http://gallica.bnf.fr/ark:/12148/bpt6k70861t>

Gallica Consultation : Les fleurs du mal / par... page Non paginé of 258 (Display: Normal)

http://gallica.bnf.fr/ark:/12148/bpt6k70861t#

Home > Consultation

Les fleurs du mal / par Charles Baudelaire
Baudelaire, Charles, 1857
Full record
Display plain text

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Thumbnail
Table of contents

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NP (not numbered)
NP (not numbered)
NP (not numbered)
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p.3
p.4
p.5
p.6
p.7
p.8

Full record

Title : Les fleurs du mal / par Charles Baudelaire
Author : Baudelaire, Charles
Publisher : Poulet-Malassis et De Broise (Paris)
Date of publication : 1857
Type : monographie imprimée
Language : French
Format : 248 p. ; 19 cm
Format : application/pdf
Copyright : domaine public
Identifier : ark:/12148/bpt6k70861t
Source : Bibliothèque nationale de France, Rés. Ye-3535
Relation : <http://catalogue.bnf.fr/ark:/12148/cb37367035f/description>
Provenance : bnf.fr
Theme : French & related literatures

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Fertig



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Les Fleurs du Mal: Digitised

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<http://gallica.bnf.fr/ark:/12148/bpt6k70861t.textePage.f1>

Text mode | Audio mode

page NP (screen 1 of 258)

[Next page](#) | [Last page](#) | NP

Title : Les fleurs du mal / par Charles Baudelaire

Author : Baudelaire, Charles

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Type : monographie imprimée

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Identifier : [ark:/12148/bpt6k70861t](http://gallica.bnf.fr/ark:/12148/bpt6k70861t)

Source : Bibliothèque nationale de France, Rés. Ye-3535

Relation : <http://catalogue.bnf.fr/ark:/12148/cb37367035f/description>

Provenance : bnf.fr

Theme : French & related literatures

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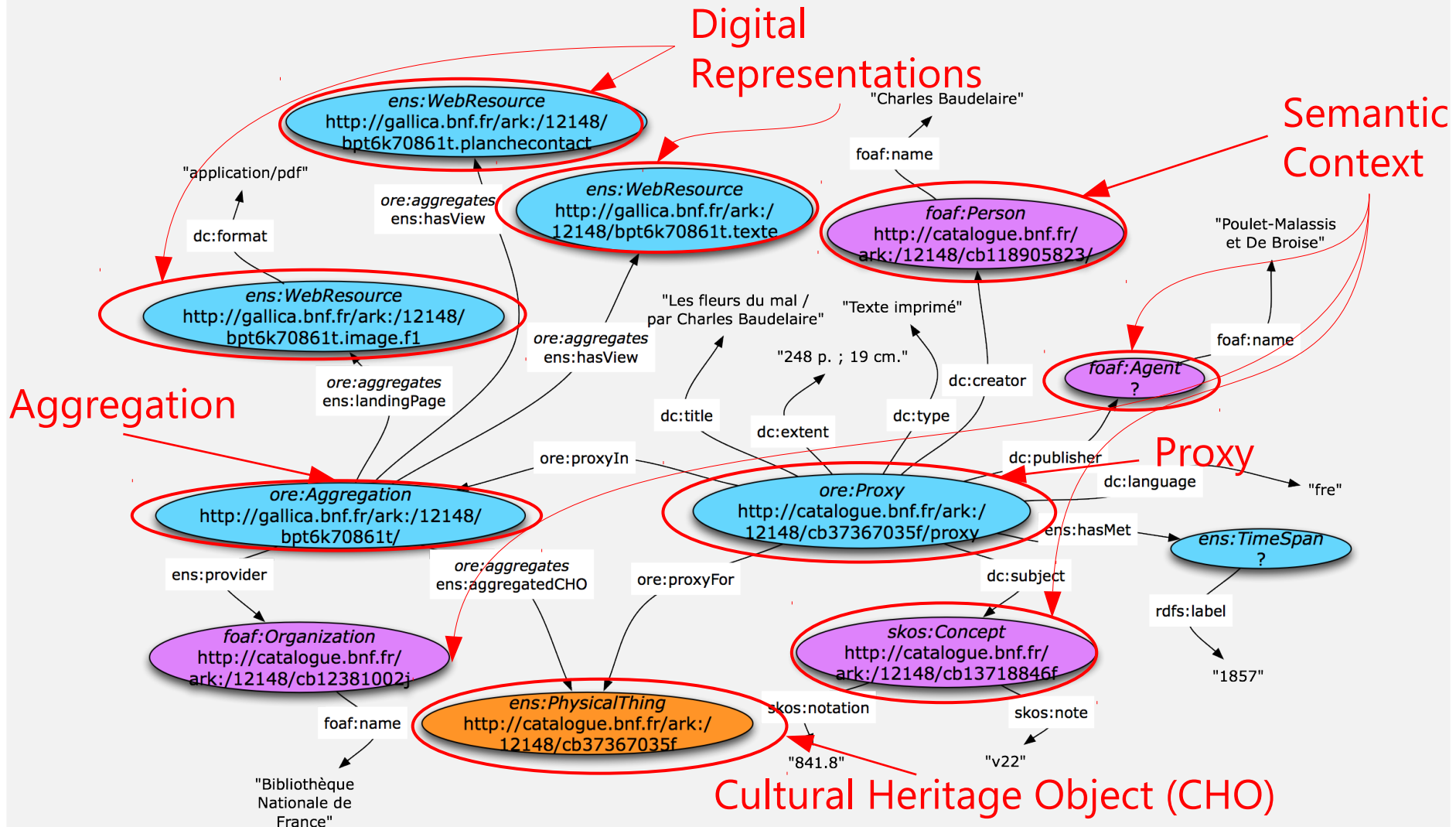
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Les Fleurs du Mal: EDM



What can you use it for: De arte venandi cum avibus

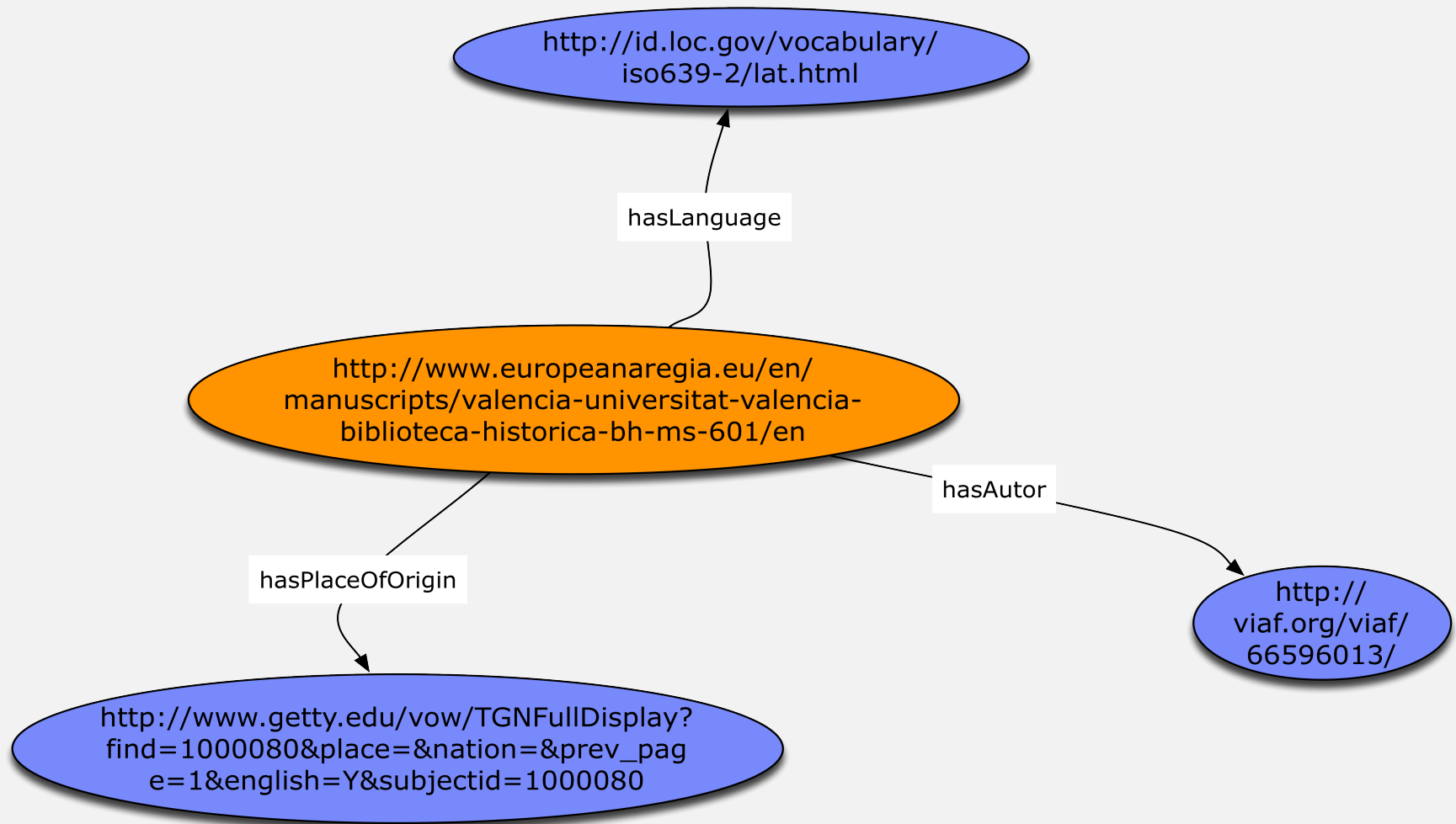
De Arte Venandi ... in Europeana Regia

Frederick II, Holy Roman Emperor: De arte venandi cum avibus. Moamin. Gerardus Falconarius. Ghatrif. Grisofus medicus



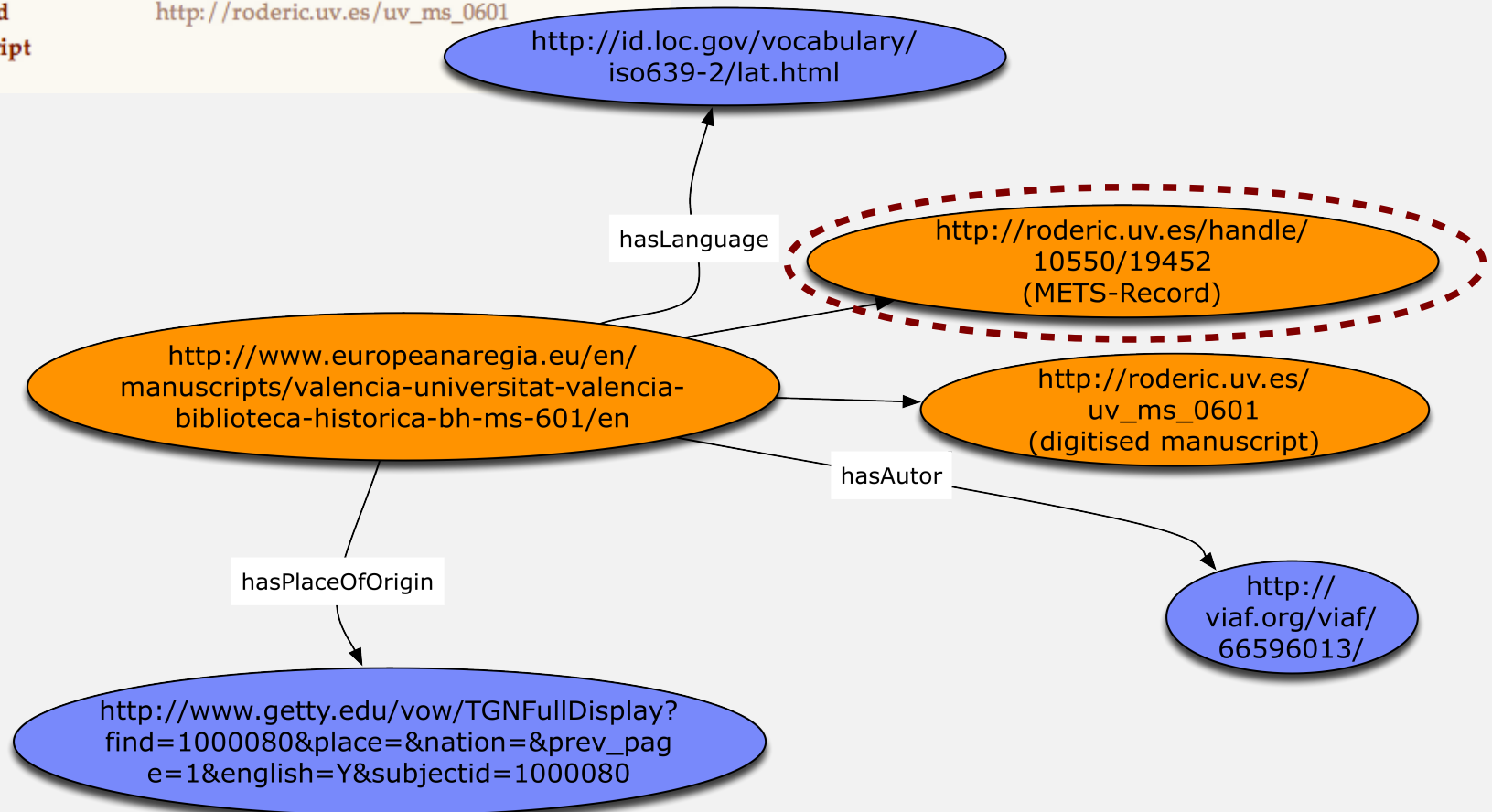
Shelfmark	Valencia Universitat de València, Biblioteca Històrica BH Ms. 601
Author	Frederick II, Holy Roman Emperor, 1194-1250 Gerardus, Falconarius Ghatrif Grisofus, Medicus
Date of Origin	around 1470
Place of Origin	Italy
Material	parchment
Extent	304 f.
Dimensions	329 x 211 mm
Illuminated	yes
Language	Latin

De Arte Venandi ... EDM version



De Arte Venandi ... there's more!

Full Manuscript Record
http://trobes.uv.es/record=b1948745
http://roderic.uv.es/handle/10550/19452
Digitised Manuscript
http://roderic.uv.es/uv_ms_0601



De Arte Venandi ... there's more (2)!

<http://id.loc.gov/vocabulary/iso639-2/lat.html>

xmlui.dri2xhtml.METS-1.0.item-somn:tableofcontents: 1. f. 3r-5r: [Prologus] "[text] Presens opus agendi nos induxit instans tua petitio vir clarissime, M. S. ... nobiles delectantur, vita comite, post complementu[m] huius operis dicetur a nobis. [rúbr.] Divi augusti Federici secundi romanor[um] usalem feti Scicilie fisci regis super librum De avibus [et] occupatione prolac[is] 2. f. 5r-56r: "[rúbr.] Incipit[ue] eius tractat[us] [et] primo de divisione g[e]n[er]aliter aviu[m] in aquaticis terrestribus [et] mediis. Item in rapacibus [et] non rapacibus. [text] In hoc autem primo tractatu huius operis dicemus generaliter de avibus ...; [f. 55r] [et] que dicuntur anates campestres [et] plures alie ...; [f. 56r] [rúbr.] Expicitus est primus tractatus"

ore:Aggregation
De Arte Venandi ...

3. f. 56r-115r: "[rúbr.] Incipit[ur] de eius particulis. ... de venatio... Ex posteriorior est q[uam] paulatina ... 4. f. 115r-145r: "[rúbr.] Incipit[ur] [ter]cius. Dictum est de mansuefactione falconu[m] cum capello. Sequi[tur] de instrumentis p[er] quos redeat ad homines. [text] Intentio n[ost]ra principio diximus est docere venationes ... [et] ledere etiam ipsos in p[er]sona. [rúbr.] Explicit liber quartus [tat]at[ur] [ter]cius" 5. f. 145r: "[rúbr.] Incipit[ur] [qu]artus. De girofalcone ad gruem, que est quidam in venatione [et] eo. [text] De ad grues ... qua[m] habent modi falcomu[m] [et] [rúbr.] Explicit liber quartus de girofalcis ad grues" 6. f. 174v-205v: "[rúbr.] Incipit liber quintus. De falcone sacro ad ayrones. [text] Determinatum est in precedentib[us] sufficienter de girofalcis ... Et grus volans percutit falconem ayro autem. Dictum est de ayronibus [et] de ayronibus. Explicit"

http://roderic.uv.es/uv_ms_0601
(digitised manuscript)

http://roderic.uv.es/handle/uv_ms_0601/1-f-3r-5r.html
(METS-Record)

edm:isNextInSequence

http://roderic.uv.es/handle/uv_ms_0601/2-f-5r-56r.html
(METS-Record)

edm:isNextInSequence

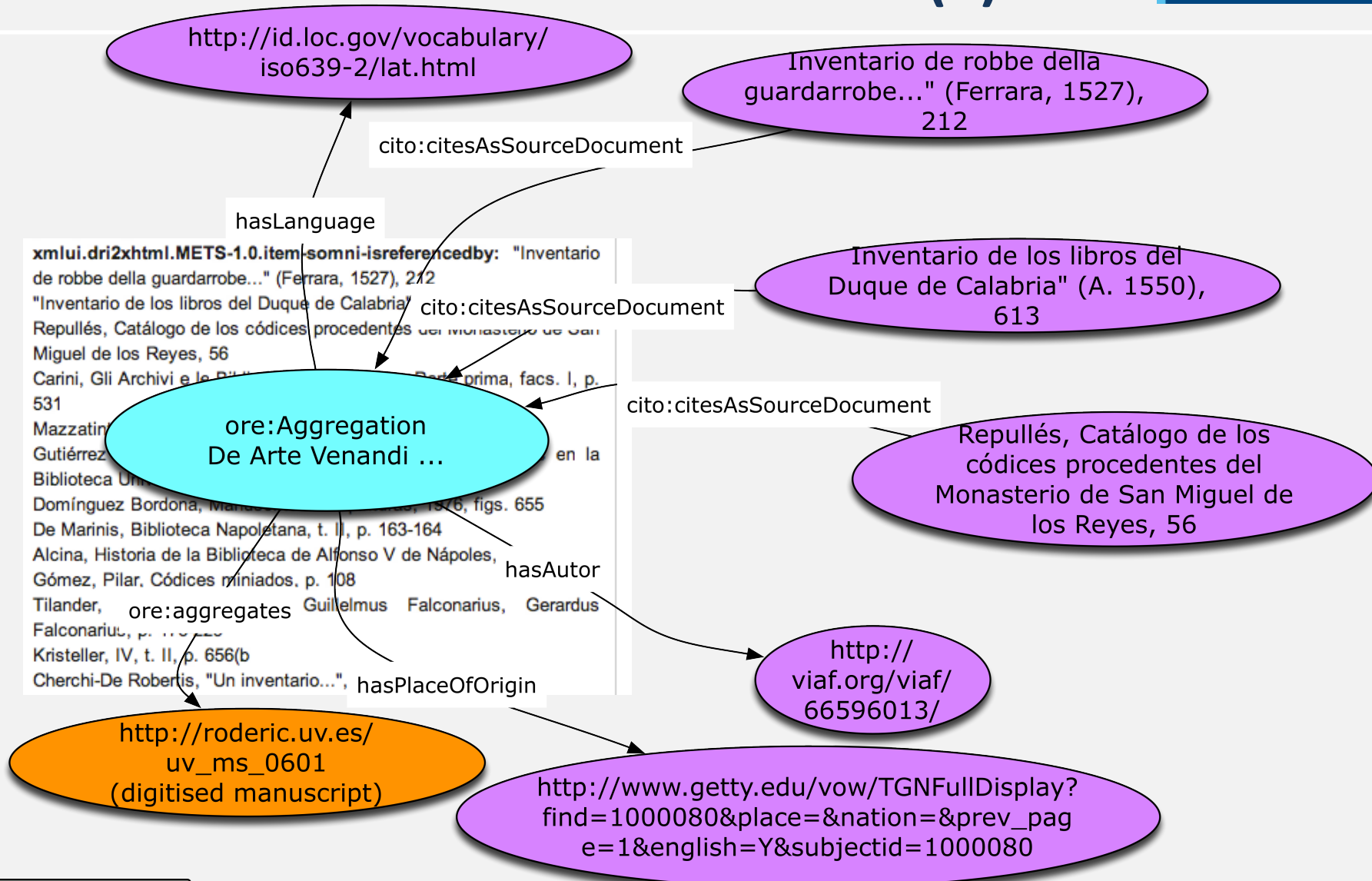
http://roderic.uv.es/handle/uv_ms_0601/3-f-56r-115r.html
(METS-Record)

<http://viaf.org/viaf/66596013/>

http://www.getty.edu/vow/TGNFullDisplay?find=1000080&place=&nation=&prev_page=1&english=Y&subjectid=1000080

Library Linked Data

De Arte Venandi ... there's more (3)!



An Opportunity Libraries ...

... and what it needs to do to be up to it

“What do you do with a million books?” (Greg Crane)

- Digitisation and semantic publishing result in
 - growing quantity
 - increased complexity
- Well beyond scholarly processing capacity (=reading faculty)
- Scientists and Scholars will badly need help in three areas:
 - **Semantic abstracting, named entity recognition** for “strategic reading” (Renear)
 - **Contextualisation** of information objects
 - Robust **reasoning and inferencing** yielding digital heuristics
- => **Opportunities for Research Libraries!**

Ceci n'est pas une bibliothèque



Ceci n'est pas une bibliothèque





The card catalog in the nave of Sterling Memorial Library at Yale University. Picture by Henry Trotter, 2005.

Catalogue Entry: MARC Record

LEADER: 00495cam 2200169 a 4500
001 94205672
003 DLC
005 2004010812243.0
008 940907s1926 gw 000 1 ger
010 \$a 94205672
040 \$aDLC\$cDLC\$dDLC
050 00 \$aPT2621.A26\$bS36 1926
100 1 \$aKafka, Franz,\$d1883-1924
245 14 \$aDas Schloss :\$bRoman /\$cFranz Kafka.
260 \$aMünchen :\$bKurt wolff verlag,\$c1926.
300 \$a505 p. ;\$c20 cm.
561 \$aSource: Bequest of Aaron Copland, Fall, 1989.\$5DLC

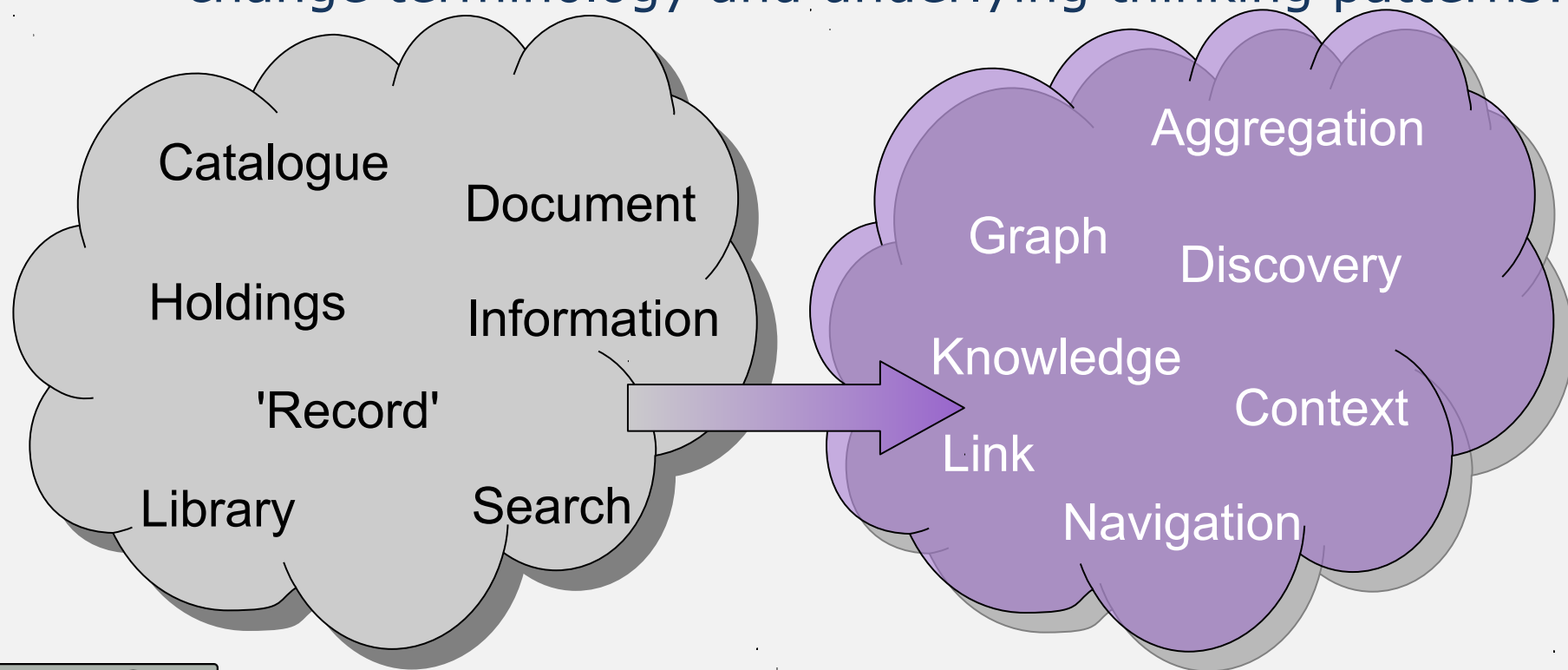
'Library Collections'



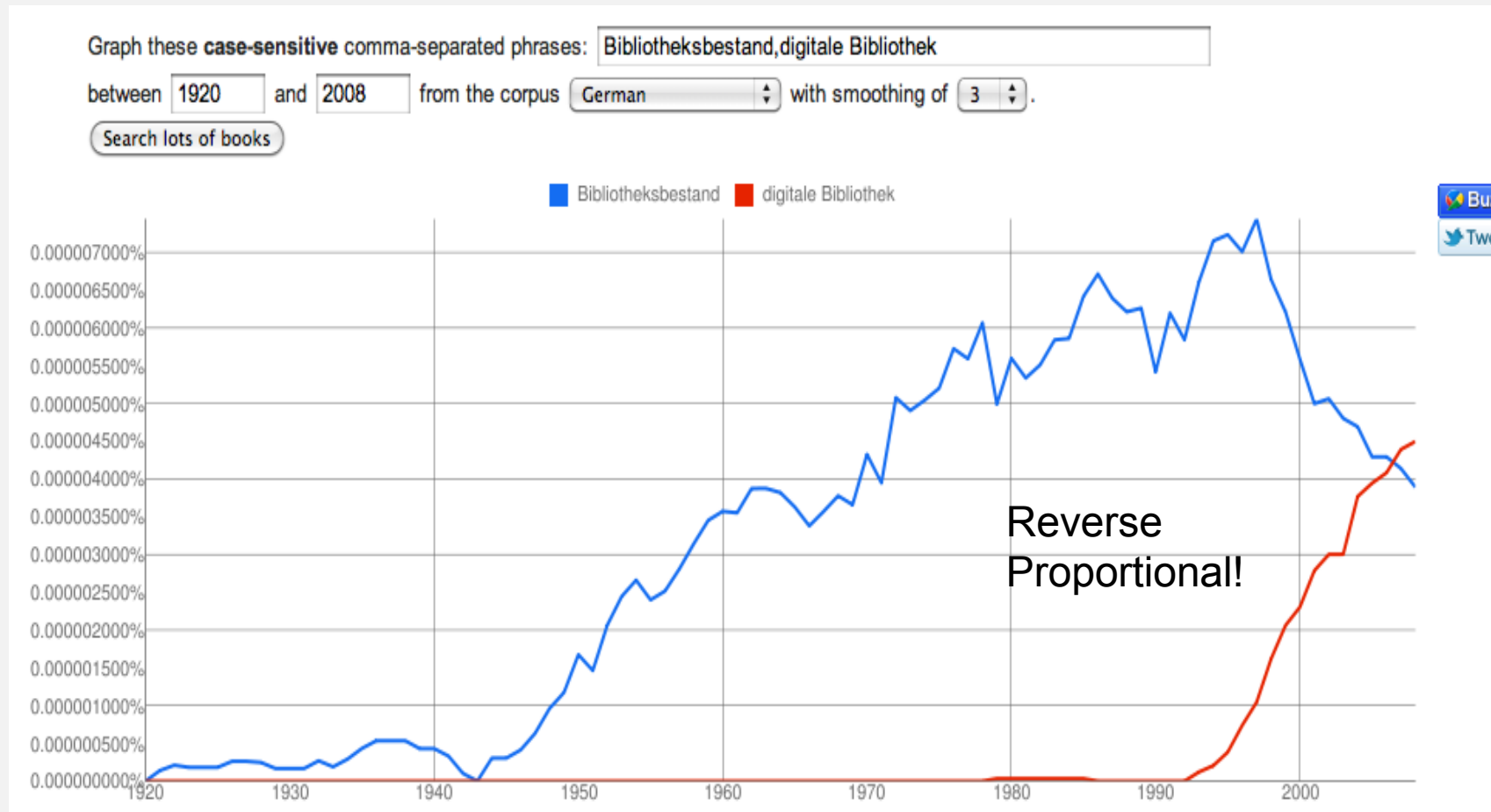
Photo © Ralf Küpper

Change Thinking, Change Terminology!

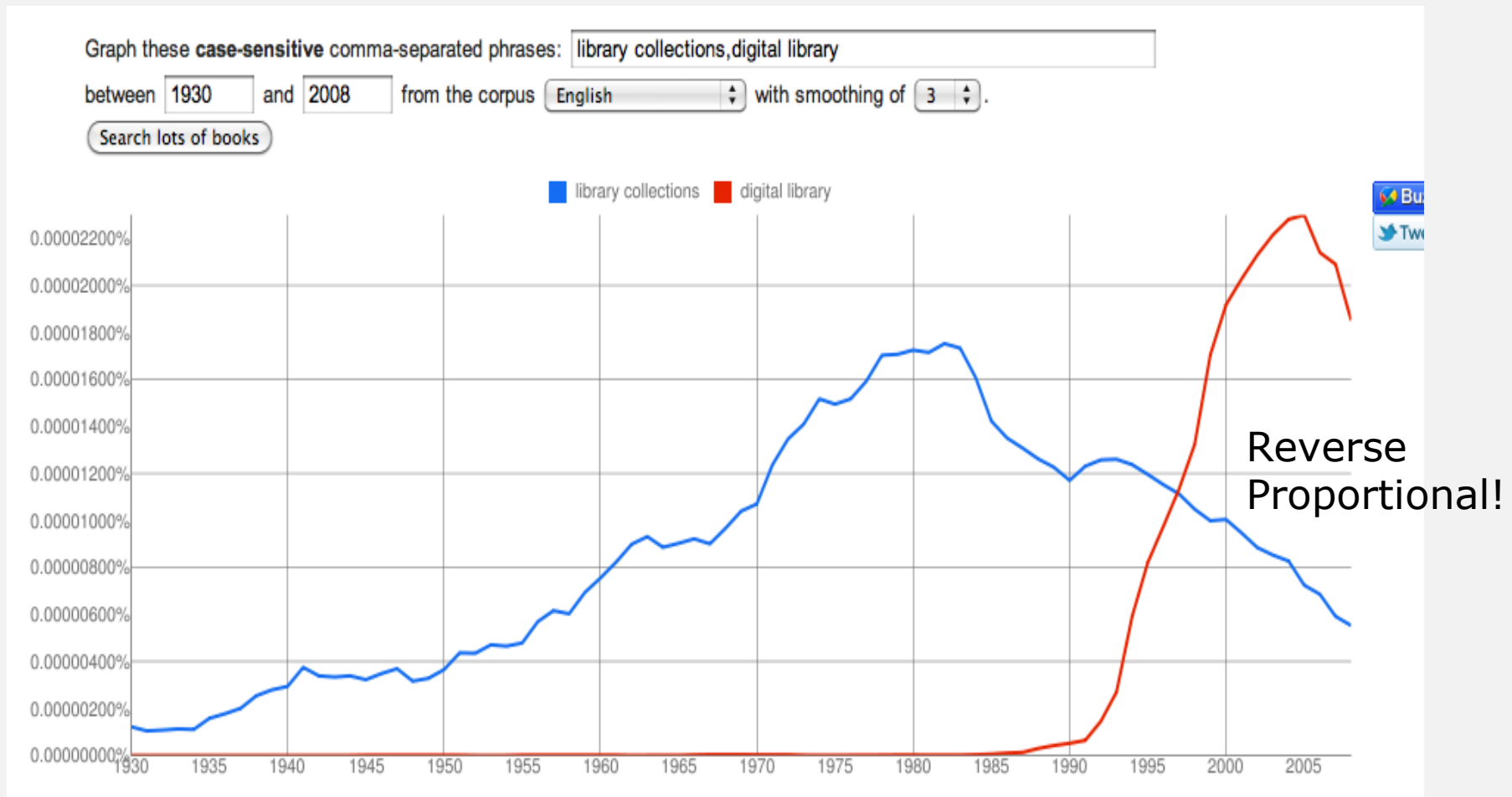
- Libraries will serve research as part of the Linked Open Data web – or else risk becoming insignificant.
- For operating this change we definitely need to change terminology and underlying thinking patterns:



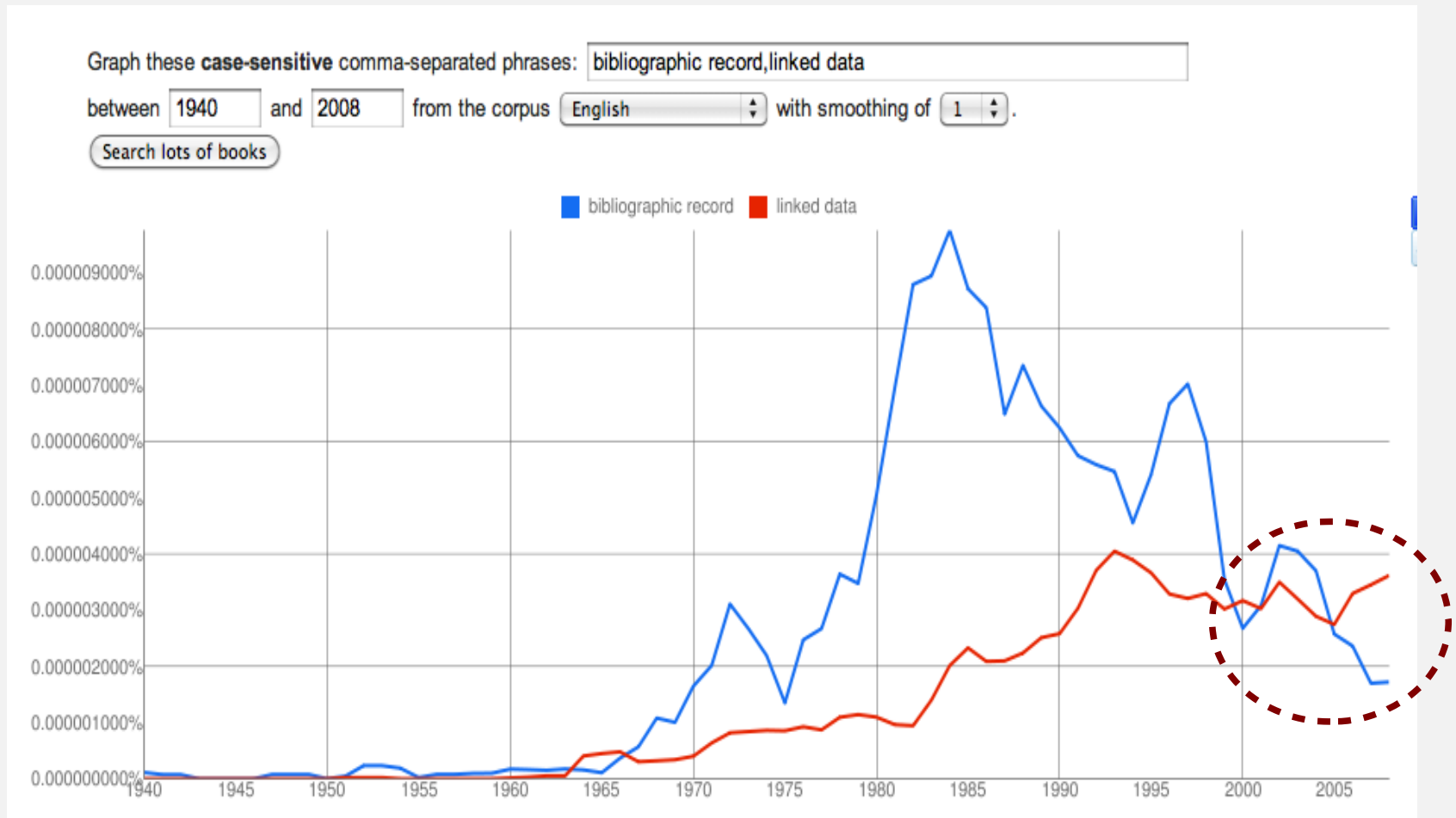
From 'Catalogues' to 'Graphs': old terms – new terms (1)



From 'Catalogues' to 'Graphs': old terms – new terms (2)

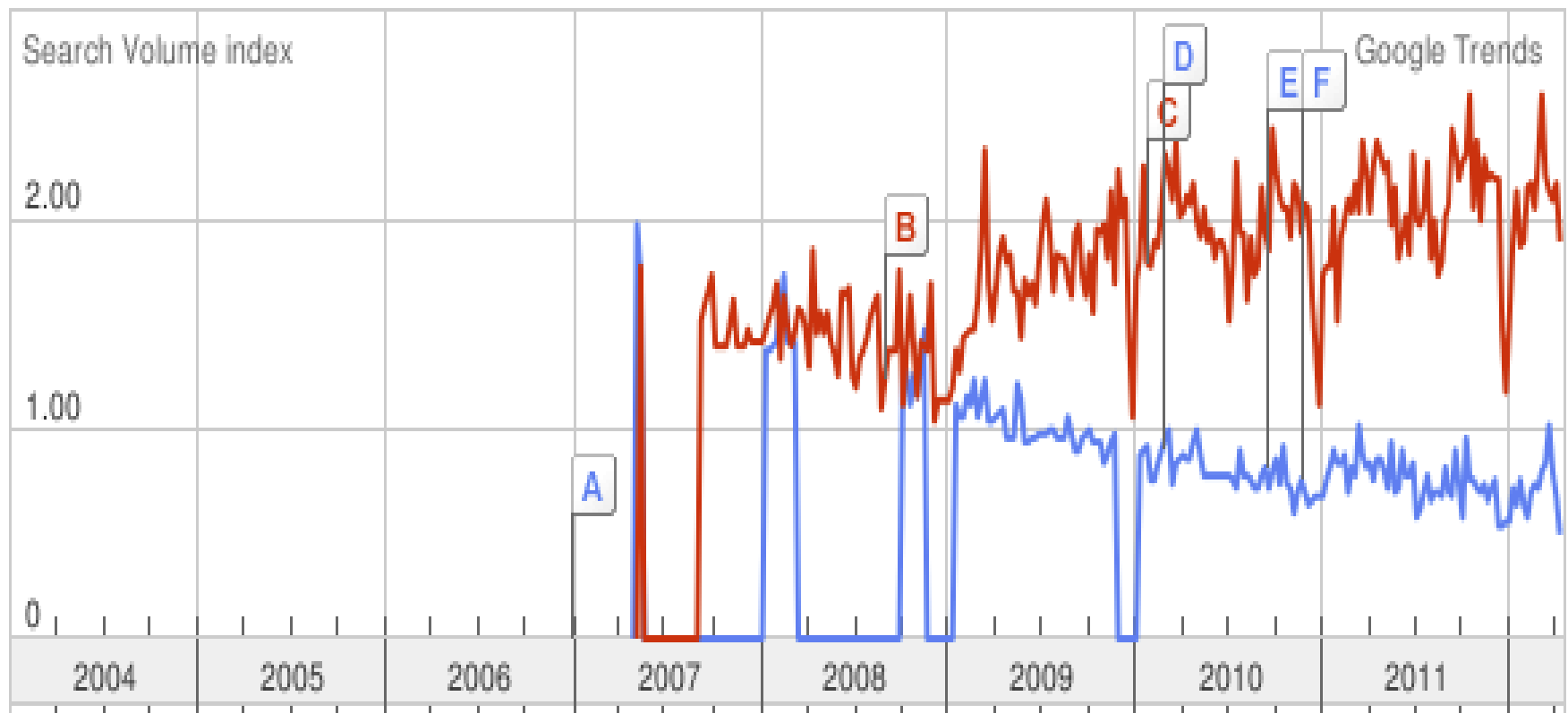


From 'Catalogues' to 'Graphs': old terms – new terms (3)



From 'Catalogues' to 'Graphs': old terms – new terms (4)

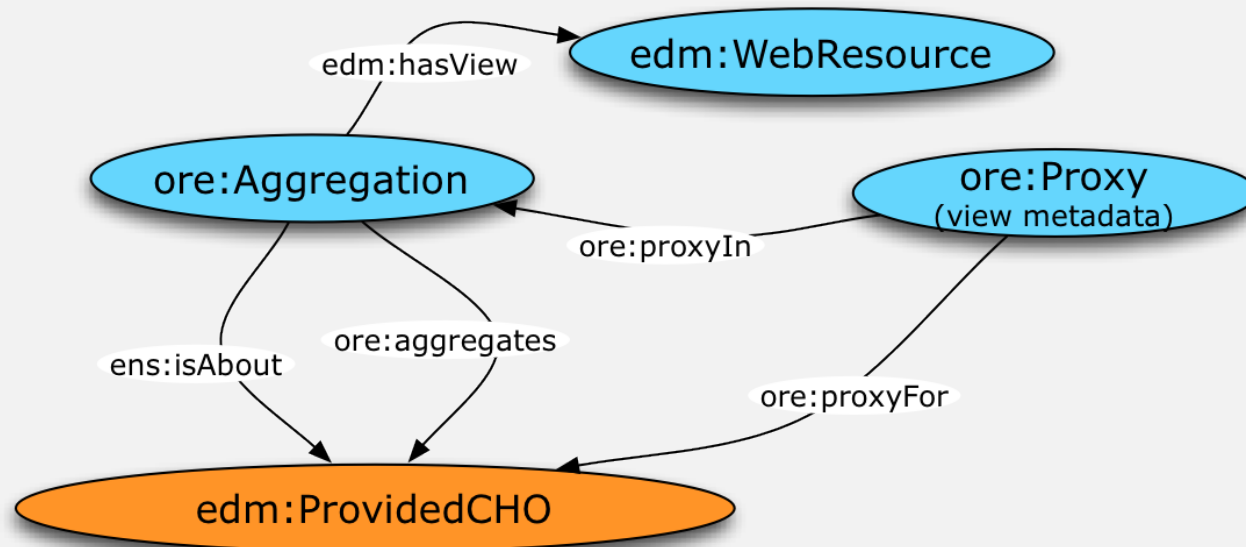
cataloguing 0.38 linked data 1.00



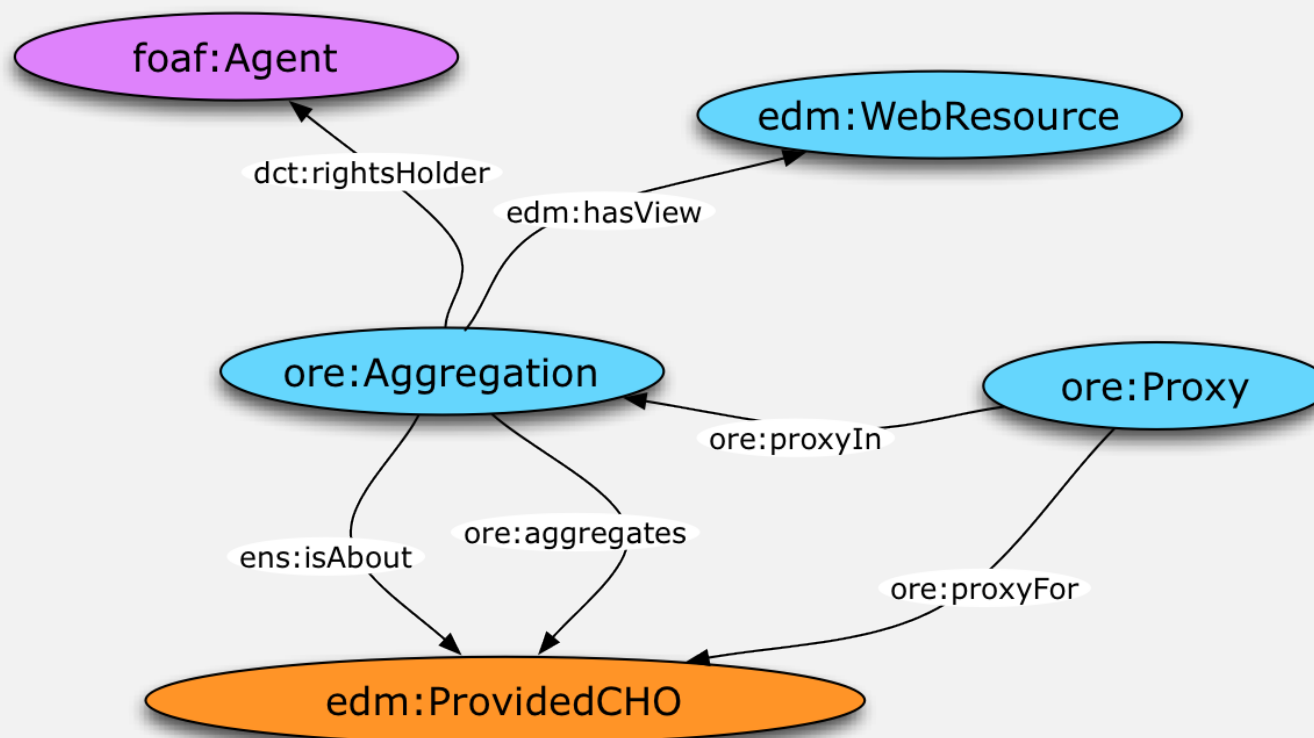


- We have learned some of these lessons in Europeana
 - we dropped the brand “EDL” very early
 - we decided not to have a 'catalogue'
- We know that the current portal is not enough
 - we devised the RDF based Europeana Data Model (EDM)
 - we are gradually migrating to EDM based operations
 - we make Europeana part of the Linked Open Data cloud

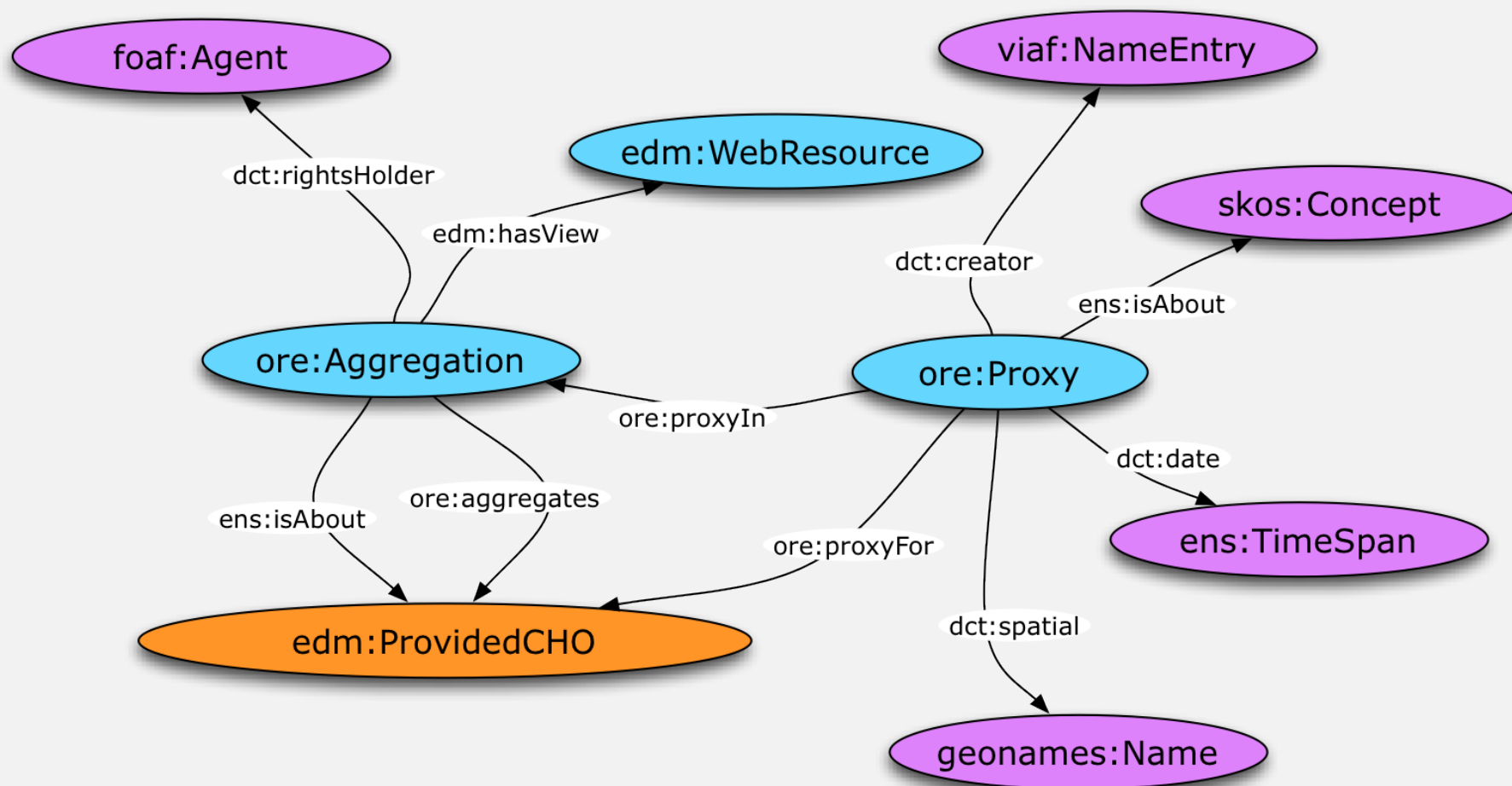
An Aggregation ...



... some context

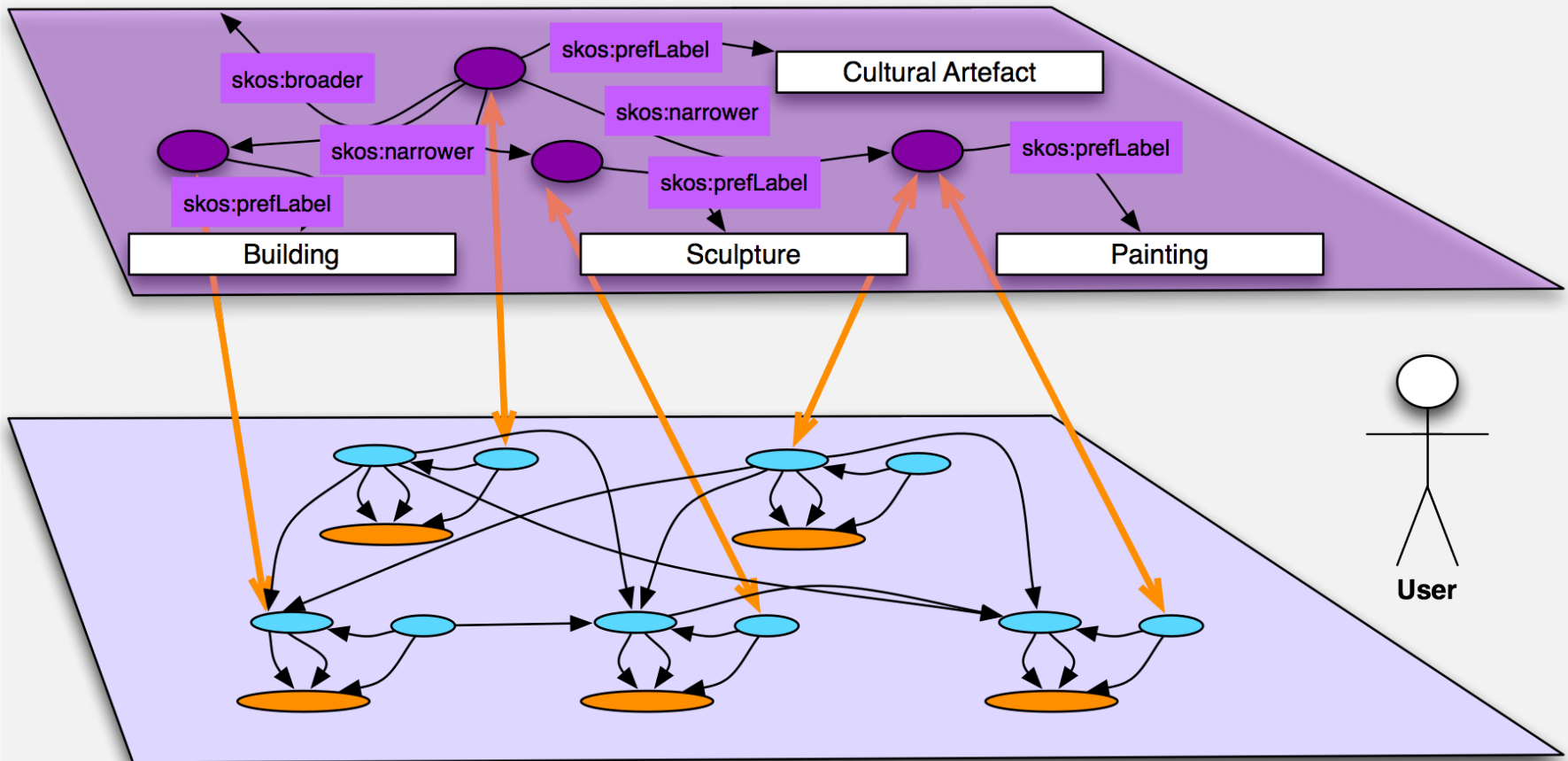


... more context



... and the Big Picture: Object and Semantic Data Layer

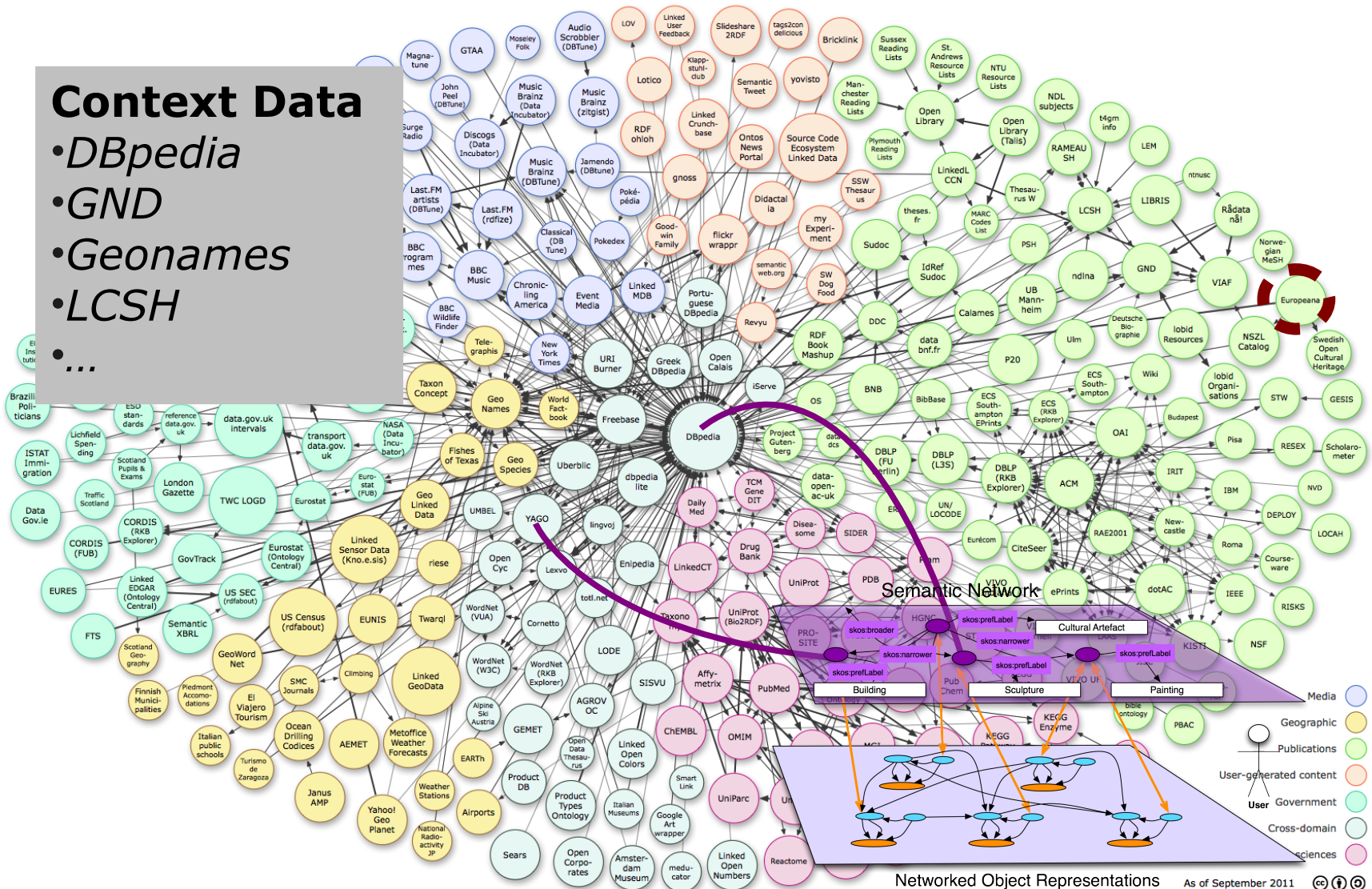
Semantic Network



Networked Object Representations

KU LEUVEN

- *DBpedia*
- *GND*
- *Geonames*
- *LCSH*
- ...



Sticking to empty metaphors ...

"What's in a name? That which we call a rose
By any other name would smell as sweet."

(Shakespeare, Romeo and Juliet (II, ii, 1-2))

Why then do we stick to emptied metaphors?

- ... because they **constitute identity** (a very bad reason!)
- ... because they guarantee **institutional persistency** (a fallacy!)
- ... because we are afraid of substantial changes and believe in **things changing only once we use new terms** (dangerously childish!)
- ... or simply because **we do not have new terms** yet?

Let us then start looking for them!

Suggested Reading

Gregory Crane (2006): What Do you Do with a Million Books? In: Dlib Magazine, Vol. 12, March. (<http://bit.ly/JhzF90>)

Gutenberg Paranthesis Research Group / University of Southern Denmark: Position Paper (<http://bit.ly/JjGKb6>)

David Parry: Burn the Boats/Books. Presentation to Digital Writing and Research Lab, Austin. (<http://bit.ly/JYLIJIV>)

David Shotton (2009a): Semantic Publishing. The coming revolution in scientific journal publishing. Learned Publishing Volume 22, No 2, 85–94, April 2009; doi:10.1087/2009202

David Shotton et al. (2009b): Adventures in Semantic Publishing: Exemplar Semantic Enhancements of a Research Article (<http://bit.ly/IgT5Km>)

Barend Mons, Jan Velterop: Nano-Publication in the e-science era (<http://bit.ly/IISMGt>)

Alan Renear, Carol Palmer (2009): Strategic Reading, Ontologies and the Future of scientific Publishing. In: Science, August 2009, p. 828 – 832.

Thank you for your patience and attention

